

UNIVERSITÉ DE GENÈVE
Institut Universitaire de Hautes Etudes Internationales

Flexible Exchange Rates and International Trade

Swiss Foreign Trade in a Changing Monetary Environment
(1968 – 1975)

THÈSE

présentée à l'Université de Genève
pour l'obtention du grade de docteur ès sciences politiques

par

JOSEF HUNKELER

de Lucerne – Suisse

Thèse No 299

1977



PETER LANG
Berne · Francfort/M. · Las Vegas
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La Commission mixte, composée des doyens des Facultés de droit, des lettres, et des sciences économiques et sociales, et du directeur de l'Institut universitaire de hautes études internationales, sur le préavis de M. Jacques L'HUILLIER, professeur à l'Université et à l'Institut, de M. Alexandre SWOBODA, professeur à l'Institut, de M. Jean-Christian LAMBELET, professeur associé, et de M. Hans GENBERG, chargé de cours à l'Institut, autorise l'impression de la présente thèse, sans entendre par là exprimer d'opinion sur les propositions qui y sont énoncées.

Genève, le 24 octobre 1977

Pour la Commission mixte:

Jacques FREYMOND

Directeur de l'Institut universitaire



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Foreword

Parturiunt montes, nascetur ridiculus mus.

This paper is the fruit of several years of quite intensive work. Having travelled extensively through many fields of economic theory I finally turned my attention back to one of the most fundamental relationships dealt with by economic theory, that is, the price-quantity relationship embodied in the most basic theory of demand. This return to the sources reflects to some extent the widespread feeling of ignorance about economic relationships triggered off by the break down of the Bretton Woods system. It may also reflect the trend to greater modesty within the economic profession accompanying these recent monetary upheavals.

The purpose of this paper is to establish a framework for the analysis of trade responses to exchange rate changes as well as to provide some detailed quantitative answers as regards the structure of Swiss imports. The particular framework developed may not be very original : Aggregation accross many commodity groups, discriminating only according to geographical origin, is too obvious a method of analysis not to have been applied before. This paper's contribution may be to have continued this line of analysis to the point where it produces tangible results relevant for balance of payments analysis.

As regards the specific price-quantity relationships analyzed, this paper's contribution is to have established - once more - that prices do matter in international trade, and that trade reactions are quite swift - but also, that true expenditure switching remains very limited. It is hoped that this understanding helps to clarify the choice of some basic assumptions for further work regarding balance of payments analysis.

Geneva, May 8 1977

J.H.

Acknowledgments

At the beginning of this book I wish to express my gratitude to those who helped me to accomplish the present work. My thanks go in particular to

Mr. J.Freymond whose general outlook, constant optimism, and constructive attitude provided much of the stamina needed to complete this study;

Mr. J.l'Huillier who awakened my interest in economics, and whose valid guidance and encouragement accompanied me throughout my studies;

Mr. W.C.Labys who aroused my interest in econometrics and who, during the period of our association, allowed me to gain useful experience not only in the academic field.

Many thanks have to be addressed, of course, to those who directed the present work. To

Mr. A.K.Swoboda for his setting of high academic standards, which may often have been painful in the short run, but which provide so much more satisfaction in the longer run;

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I wish to thank Ives for making me aware of the very relative relevance of the significance estimates of many of my exercises, as well as for providing a safe haven whenever I ran into computational difficulties.

Many thanks go to my longstanding friends Taka, In Su, but also to Mr. R.Shizuki who during often almost endless debates managed in a catalytic manner to help crystallize my ideas as well as to eliminate many obstacles and to avoid perfectly blind allies. Thanks go, of course, also to René, Jocelyn and Nga who - fighting in the same struggle - provided encouragement at times when spirits were rather low and abandonment a rather too realistic alternative to the conclusion of the present work.

Last but not least I would like to thank the Republic and Canton of Geneva for having put such excellent computer facilities so generously at the researchers' disposal.

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Abbreviations and Symbols

The abbreviations used for our variables have all the form EP_i , RP_i , UPM_i or LEP_i , LRP_i , $LUPM_i$ where $i = D, F, I, UK, US$ represents the country of origin, that is, Germany, France, Italy, the United Kingdom, and the United States.

The prefix "L" stands for logarithmic version

"E" is the exchange rate (in terms of Swiss francs)

"P" is the price level (if not specified : the wholesale price = WPI)

"EP" is the wholesale price franc-equivalent

"RP" is the relative price $EP_i / \text{World price}$ (defined p. 58)

"UPM" is the unit price of imports (in Swiss francs)

"MS" is the import share in quantity terms (defined p. 57)

" w_i " is the import share in value terms used as weight for the computation of a "world price index" (defined p. 56)

" $\bar{w}_i$ " is the average value of w_i , monthly data 1968.1 - 1975.12

D.W. stands for the Durbin-Watson test statistic

IFS stands for International Financial Statistics (published by the International Monetary Fund, Washington)

Thus, $LMSUK_{-3}$ is the logarithmic version of the import share variable concerning imports into Switzerland originating in the United Kingdom, lagged three periods. EPI is the franc-equivalent of the Italian wholesale price, etc.

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I. Introduction

a) The General Setting

The lack of understanding of the working of the flexible exchange rate system is quite blatant. This is documented by the small - although growing - number of analytical studies available at present as well as by the continued popularity of devaluation analysis in a context of fixed exchange rates. We live now already in the sixth year of a period of frequently changing if not truly flexible exchange rates.

Theoretical work on the flexible exchange rate system has been rather limited. Most advocates of a system of flexible exchange rates have argued for greater flexibility not out of a profound understanding of such a system, but mainly out of despair over the harsh code of good conduct accompanying the Bretton-Woods system.¹⁾ Flexibility in the exchange rates is supposed to provide the freedom for each country to pursue independently of the rest of the world the goals of internal stability without being forced to subordinate domestic economic policy continuously to balance of payments considerations. This is the main argument in Friedman's "Case for Flexible Exchange Rates".²⁾

-
- 1) A discussion of arguments for greater flexibility of the exchange rate together with a large number of references is presented in KASPER, W., Zur Frage grösserer Wechselkursflexibilität, Kieler Studien 113, Tübingen, J.C.B. Mohr, 1970
 - 2) FRIEDMAN, M., "The Case for Flexible Exchange Rates" (1950) reprinted in CAVES, R.E., JOHNSON, H.G., eds., Readings in International Economics, Homewood Ill., R.D. Irwin, 1968, pp. 411 - 437. The same was still the dominating argument more than 15 years later in FELLNER, W., "On Limited Exchange-rate Flexibility", reprinted in COOPER, R.N., ed., International Finance, Harmondsworth, Penguin Books Ltd., 1969, pp. 212 - 222, which includes a statement, signed by 27 economists, demanding more exchange rate flexibility.

Fundamental attempts to understand the working of a flexible exchange rate system were made by Laursen and Metzler in their well-known article "Flexible Exchange Rates and the Theory of Employment" as well as by Mundell in his "International Economics".¹⁾

It may be symptomatic of the profound lack of understanding to see the flexible exchange rate system treated often merely in a footnote to a treatise on the fixed exchange rate mechanisms. In fact, most textbooks will define the flexible exchange rate system as a system in which the Central Bank no longer intervenes, rather than to define the fixed exchange rate system as a special case of a flexible exchange rate system in which the flexibility is limited by the buffer stock activity of the Central Bank. Only the very recent monetarist approach seems to provide a framework equally well suited for the analysis of the alternative systems.²⁾

Though the analytical work on the topic seems to consist mainly of variations on the received theory³⁾, there have been a number of empirical studies dealing with special aspects of the system

1) LAURSEN, S., METZLER, L.A., "Flexible Exchange Rates and the Theory of Employment", Review of Economics and Statistics, 1950, No. 32, pp. 281 - 299.

MUNDELL, R., International Economics, New York, Macmillan, 1968, chapters 11, 17, 18 written 1960/61 ; this book, incidentally, contains one of the most convincing arguments against a generalized system of flexible exchange rates, cf. chapter 12 "Optimum Currency Area".

2) cf. e.g. MUSSA, M., "The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy Under a Regime of Controlled Floating", The Scandinavian Journal of Economics, 1976, pp. 229 - 248.

3) cf. e.g. references in a survey article by GRAF, G., "Hypothesen zur internationalen Konjunkturtransmission", Weltwirtschaftliches Archiv, 1975, pp. 529 - 563, particularly pp. 539 ff and 554 ff.

such as interest and goods arbitrage (particularly the price-exchange rate relationship).¹⁾

Our own interest in this field has, for a long time, centered around the basic problem of exchange rate determination. But questions related to the stability of such a system of flexible exchange rates - as explored by the path breaking article by Laursen and Metzler - provided the necessary incentive to reconsider the fundamental relationships between external and internal equilibrium, between the exchange rate and domestic employment.

1) cf. e.g. BLACK, S.W., International Money Markets and Flexible Exchange Rates, Princeton Studies in International Finance No. 32, Princeton, Princeton University Press, 1973.

ALIBER, R.Z., "The Interest Rate Parity Theorem : a Reinterpretation", Journal of Political Economy, Nov./Dec. 1973, pp. 1451 - 1459.

FRENKEL, J.A., LEVICH, R.M., "Covered Interest Arbitrage : Unexploited Profits ?", Journal of Political Economy, April 1975, pp. 325 - 338.

DUNN, R.M., "Flexible Exchange Rates and Traded Goods Prices", in JOHNSON, H.G., SWOBODA, A.K., eds., The Economics of Common Currencies, London, George Allen and Unwin, 1973, pp. 259 - 280.

JUNZ, H.B., RHOMBERG, R.R., "Price Competitiveness in Export Trade Among Industrial Countries", American Economic Review, May 1973, pp. 412 - 418.

MAGEE, S.P., "U.S. Import Prices in the Currency-Contract Period", Brookings Papers on Economic Activity, 1974.1, pp. 117 - 168.

HODGSON, J.S., PHELPS, P., "The Distributed Impact of Price-Level Variation on Floating Exchange Rates", Review of Economics and Statistics, Feb. 1975, pp. 58 - 64.

At that stage, we assumed the direct relationship between the trade balance and the exchange rate to provide the key for the understanding of a flexible exchange rate system. The fulfillment of the "Marshall-Lerner" condition was recognized to be the essential prerequisite for stability and, thus, for the meaningful working of such a system.

However, trade is not the only element determining demand and supply in the foreign exchange markets. It was recognized that operations like interest arbitrage - to take advantage of short term interest differentials - or long term capital movements - for "true" investment purpose - could play an important role in determining the foreign exchange rate. The recent development (or rather revival) of the "monetarist approach" to the balance of payments analysis, which is based on the predominance of considerations of portfolio balance - in which trade appears mainly as a residual item or as an instrumental element - is the logical outgrowth of this recognition, brought home clearly to everyone by the international developments of the last few years.

* * *

The earlier approach, ignoring capital movements almost completely, was interested essentially in the determination of prices clearing the international markets : In the absence of capital movements and with commodity prices fixed in domestic currencies, these prices are equivalent to the terms of trade and, with suitable choice of currency units, to the exchange rate. Given the basic assumption of the flexible exchange rate system that the balance of payments (here read balance of trade) can never be in disequilibrium, that is, the value of exports must always match exactly the value of imports, it is obvious that any real variation in either imports or exports not counterbalanced by an identical change in the other must change the market clearing price, that is, the exchange rate. The idea that this new market clearing exchange rate would influence the subsequent trade behavior which in turn would determine the exchange rate was the fundamental skeleton of the elasticity approach. It was recognized that, whatever the speed of adjustment might be, this system could be stable and thus operable

only if the aggregate trade elasticity be larger than unity. The implicit assumption of constant elasticities of demand, independent of the magnitude of the price change or of the response distribution through time, did not seem implausible at that stage since the reasoning was done essentially in terms of marginal changes and considering only long run effects.

The growing importance of foreign exchange transactions not directly related to trade made it necessary to review the just described close relationship between exchange rates and trade. While this additional element entering the foreign exchange market did not affect the postulated response of trade to exchange rate variations, the other side of the elasticity approach, the determination of the exchange rate, clearly needed reexamination.

The existence of forward exchange markets makes international interest arbitrage an almost risk free enterprise. While interest arbitrage only equalizes the forward premium or discount with any given interest differential, it was recognized that interest arbitrage would determine the spot exchange rate unequivocally whenever speculators would determine the forward rate. It is obvious that the introduction of interest arbitrage and speculation leaves little scope for the earlier concept of the exchange rate as the market clearing rate of exchange between imports and exports. Interest rates and speculators' expectations rather than the quantities traded become the determinants of the exchange rate.¹⁾ The above argument, obviously, hinges on the assumption that arbitragists adjust the premium (or discount) to a given interest differential (determined largely outside their influence in the national money markets) rather than the latter to a given combination of spot and forward exchange rates (determined by the necessity of clearing trade and autonomous capital flows). While it is recognized by the monetarist

1) In the absence of forward markets interest arbitrage in the above sense is impossible, but generalized speculative behavior, that is, portfolio balance decisions based on expected yields of assets (including all currencies as possible assets) may produce a similar result.

inspired theories that there exist links between trade on the one side, spot and forward exchange rates on the other, they are, in a perhaps too easy analogy to stock or commodity future markets, assumed to be negligible.¹⁾

Modern technology making minute to minute arbitrage adjustment possible provided the opportunity to link the exchange rate almost perfectly to the respective interest rates and thus contributed to make the short-term determination of the exchange rate an essentially monetary phenomenon, almost entirely detached from actual trade. While trade still may affect the exchange rate determination, be it through the formation of expectations or through the variations in national wealth brought about by trade (or rather current account) imbalances affecting the domestic assets markets, the direct link from trade to the exchange rate appears to be broken. This, obviously, reduces the analytical interest of the relationship between trade and exchange rates considerably.

But even the other side of the relationship we are interested in, the determination of trade, had to be reviewed in the light of the new theories. One of the major contentions of the monetarist

1) cf. stock markets where the value of the stocks relates rather vaguely to the actual value of the companies they represent. Should bank notes be considered to be shares of enterprises called "national economies?" On this cf. MUSSA, M., op. cit., p. 239.

On commodity futures trading cf. LABYS, W.C., GRANGER, C.W.J., Speculation, Hedging and Commodity Price Forecasts, Lexington Mass., D.C. Heath and Company, 1970, p. 17 and tables 1-3, 1-4, pp. 18 - 20, who show that the ratio of futures trading to actual physical trading of eleven basic commodities (U.S. 1950 - 1969) varied between 50 to one and 200 to one.

On the importance of flow variables versus stock variables in exchange rate determination cf. DORNBUSCH, R., "The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy", The Scandinavian Journal of Economics, 1976, pp. 255 - 275, particularly pp. 260 - 263.

approach ¹⁾ is that the overall trade (read current account) balance is determined by the aggregate desire for wealth accumulation.²⁾ Should we conclude that exchange rate changes have no direct effect on trade at all ? This would clearly be excessive. It cannot be our argument here to arbitrate between different views. Clearly, in an analysis which has moved away from only partial considerations and operates in a general equilibrium framework, discussions about one-way causal relationships become immaterial : In an interdependent system all interacting elements must be taken into account. But, as we have seen that adjustment of the exchange rate to imbalances in the different domestic money markets may be almost instantaneous, it has to be recognized that actual goods' prices change rather slowly and that, therefore, purchasing power parity may not obtain in the short run.³⁾ Thus, exchange rate variations can affect the relative prices of tradables and, following the pure theory of international trade, affect the international exchange of goods.⁴⁾

* * *

1) in analogy to the absorption approach

2) cf. JOHNSON, H.G., "The Monetary Approach to Balance of Payments Theory", in CONNOLLY, M.B., SWOBODA, A.K., eds., International Trade and Money, London, George Allen and Unwin Ltd., 1973, pp. 206 - 224, particularly p. 207, discussing the balance of payments determination.

3) cf. DORNBUSCH, R., op.cit., pp. 260 - 263.

4) That the changes in the trade flows induced by such exchange rate variations will have repercussions in the national money markets and thus have feed back effects on the exchange rate certainly has interesting implications for the dynamics of the system. While exchange rate variations may be the result of portfolio changes (perhaps in a third country) between domestic and foreign assets and allow to equilibrate the expected return on these assets they do not necessarily affect the total stock of assets held in any economy. Trade imbalances on the other hand affect the total stock of assets and thus allow adjustments in the relationship between income and wealth.

Of course, our initial hope, that an investigation into the exchange rate trade relationships might provide deep insights into the working of a flexible exchange rate system, is long gone. But the hope that such an investigation might produce theoretically relevant and interesting insights still remains.

That trade imbalances brought about by exchange rate variations produce flows of assets, at least in the short run ¹⁾, might be reflected in speculators' expectation formation. That these flows of assets represent real changes in the respective stocks of wealth and as such will affect the national assets markets and in turn the exchange rate certainly would make it desirable to have an idea about the speed of the original trade response to exchange rate changes. There is little need to assert that the long run is essentially a successive series of short runs to underline the relevance of these last considerations.

While these questions are of doubtless interest and merit further investigation, we shall in the following chapters be concerned only with the basic relationship between exchange rates, prices and trade.²⁾ Unless we understand how trade flows react to exchange rate changes, the above considerations will remain necessarily of speculative character and thus of little practical value.

More important than to understand these possible repercussions on the exchange rate determination, however, are the implications we can draw from such an analysis with regard to the elementary desirability of such a flexible exchange rate system. If it can be shown that trade is to quite an extent indifferent to exchange rate variations then one might argue that these changes are only "mone-

1) For a devaluation of the domestic currency a trade elasticity smaller than unity will provoke a trade deficit and thus an outflow of assets while a trade elasticity larger than unity (cf. Marshall-Lerner condition) will produce a trade surplus and thus an inflow of internationally tradable assets.

2) Assuming, of course, that such a direct relationship exists, operating otherwise than only through monetary channels.

tary", that is, that they do not have in the aggregate any real - be it damaging or beneficial - effect.¹⁾ But, if trade can be shown to respond to these changes, it would be desirable to know by how much and how fast. Once these reactions are known we may attempt to formulate some kind of cost benefit analysis. Before we do have such precise informations, any statements in this area will be pure speculation.

1) Except for domestic transfers, etc.

b) The Specific Case of Switzerland

Why such a study on Switzerland? The most obvious reason is, of course, the desire to understand our own system in which we live and work. Switzerland is a small open economy, trading worldwide in a large range of products. It is, therefore, plausible that, if there is any trade reaction to exchange rate variations to be found, we should be able to find it in the Swiss foreign trade relations. Exchange rate changes have occurred frequently ever since June 1971 when the Swiss-franc/dollar relationship was modified for the first time in more than thirty years.

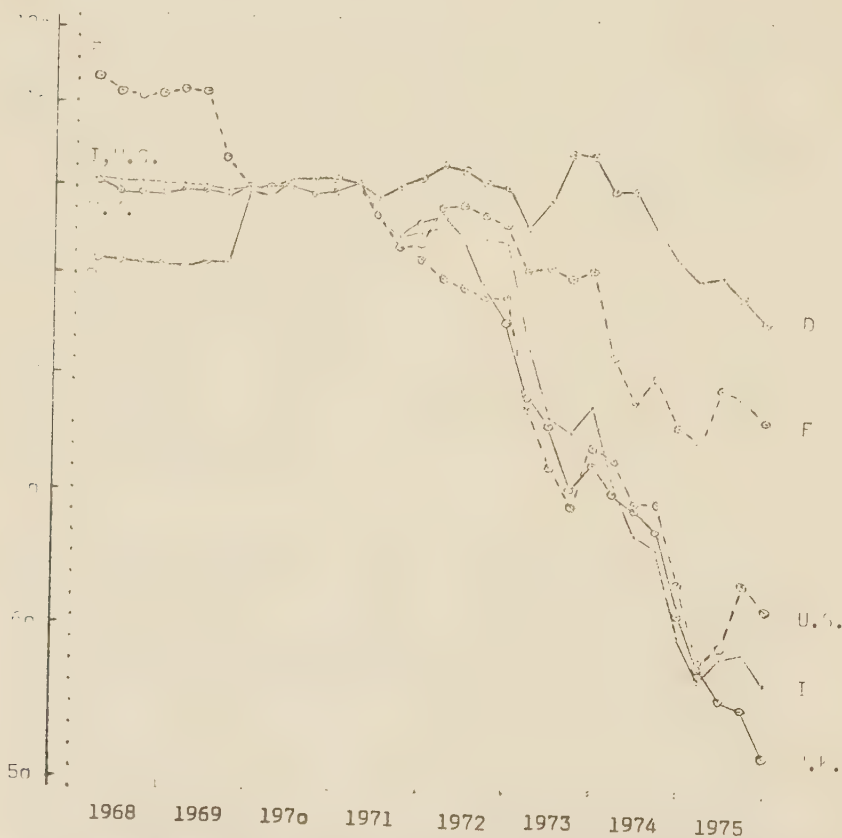


Fig.1 Exchange Rates in Terms of Swiss Francs, indexed 1971.I = 100
 D = German Mark, F = French Franc, I = Italian Lira,
 U.K. = Pound Sterling, U.S. = U.S. Dollar

Switzerland's position as an international banker may explain some of the most erratic capital movements (read portfolio adjustments) and subsequent disturbances in the foreign exchange market experienced in recent years. It may also explain some of the longer term developments regarding the exchange rate determination as will be argued below. But the fact that exchange rate changes do occur and that they do affect relative prices of national outputs - at least in the short run - is certainly not a specifically Swiss phenomenon.

Before entering any theoretical considerations, let us set the stage with a short description of the Swiss foreign exchange market. Fig.2 may provide a suggestive picture of the situation. Comparing Swiss foreign exchange holdings with the Swiss-franc/dollar exchange rate we notice quite some symmetry.¹⁾

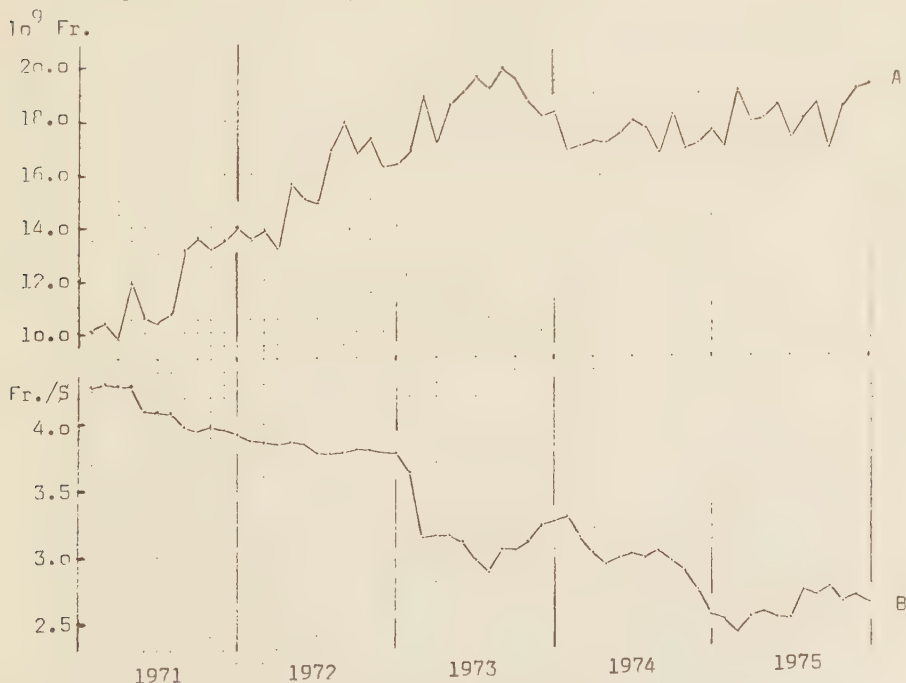


Fig.2 Foreign Exchange Holdings and Exchange Rate

A Proxy for Swiss Foreign Exchange Holdings

B Swiss-franc/U.S.-dollar Exchange Rate

While this graph is essentially a reflection of the Central Bank's buffer stock activity and as such is of little interest for our present purpose, it allows to illustrate the order of magnitudes of the fluctuations present in the foreign exchange market. If we compare the variations of this bufferstock proxy with the actual trade deficit (Fig.3), comparing thus the residual flow demand for foreign exchange (approximately the official settlements account) with the trade induced flow demand for foreign exchange, we can deduce easily the high degree of volatility which must be prevalent in the capital sector since it is highly implausible that these large movements be produced in the service account.

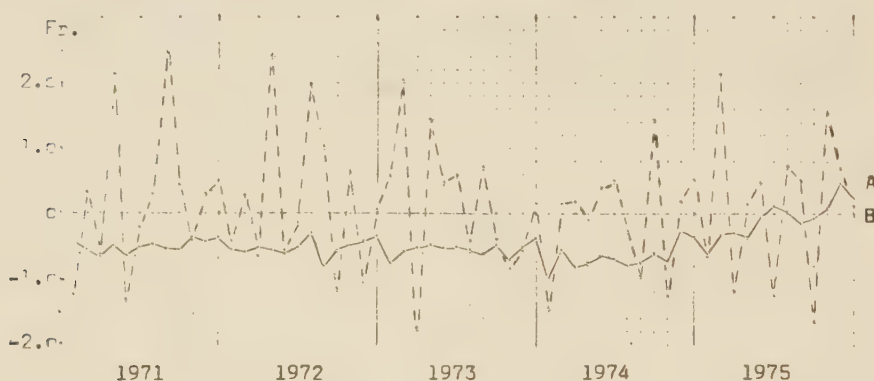


Fig.3 Foreign Exchange Holdings and Trade Balance

A Variations of proxy for Foreign Exchange Holdings (---)
 B Trade Deficit (—)

-
- 1) (to previous page) The proxy for the Swiss foreign exchange holdings (which may be considered the domestic foreign exchange buffer stock) is the National Bank Foreign Assets (International Financial Statistics, line 11) minus the Deposit Money Banks' Reserves (line 20). While this procedure distorts the absolute figures it eliminates spurious seasonal variations which are clearly due to window dressing operations of the Deposit Money Banks (using the Central Bank's swap facilities. In 1975 the Central Bank's credit facilities rather than swaps were used for this purpose whence the seasons appearing clearly in Fig.3. cf. Banque Nationale Suisse, Rapport annuel 1975, p.40).

Thus we can imagine Switzerland to be a small island in the ocean of international liquidity, and disturbances, even originating far away, will finally show their effects on our shores. While we may not know what makes the waves come in, we cannot ignore the fact that they are there.¹⁾

Whether such short turbulences can have an effect on the exchange rate will depend on the institutional set up.²⁾ The monetarists' approach has taught us, however, to look rather at the larger aggregates of stocks of assets than at short term turbulences connected to their adjustment if we are to understand the working of the foreign exchange markets. In this view we may turn to the longer term aggregates of the Swiss balance of payments accounts given in Fig.4.³⁾

This graph is interesting in several respects. First, it seems to show that Switzerland has consistently been a capital exporter. This may be nothing new since we know that all the erratic capital inflows are usually quickly neutralized by the commercial banks exporting equivalent amounts of capital back into the rest of the world.

-
- 1) cf. massive dollar inflows July-August 1971, June-July 1972, etc.
 - 2) The above Fig.2 would certainly not refute the possibility of even such a short term connection.
 - 3) There appears a contradiction between the two graphs as far as capital movements are concerned, particularly in 1975. IFS line 79 reports reserve variations of 1.16 billion U.S.-dollars while our proxy for the bufferstock holding shows a variation of only 1.75 billion Swiss-francs. Notice the cautioning remark given in IFS "... but complete data on foreign assets and liabilities are not available. Hence the Monetary Survey neither reflects the domestic monetary effect of the banking system's foreign transactions nor indicates the importance of Switzerland as an international financial center." International Monetary Fund, International Financial Statistics, (IFS), Washington, Aug. 1976, p. 416.

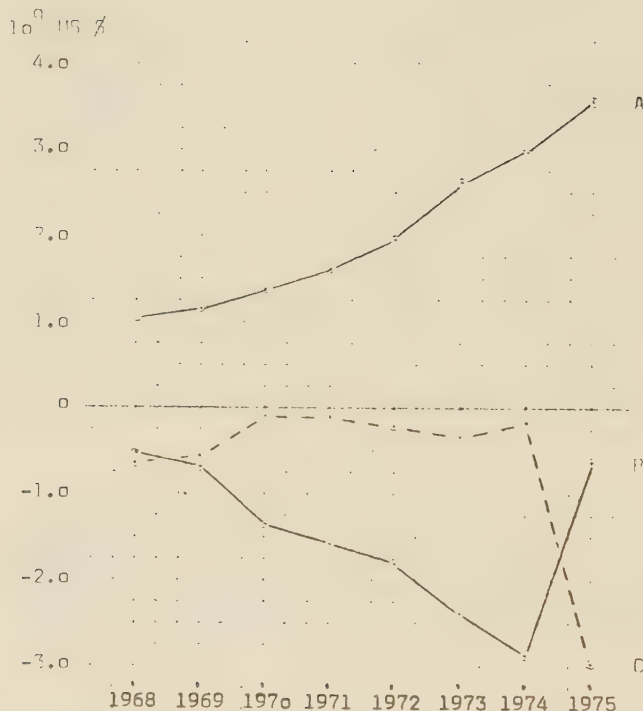


Fig.4 Swiss Balance of Payments Accounts (billions of U.S. \$)

- A Service Balance (surplus)
- B Trade Balance (deficit, including unilateral transfers)
- C Residual Capital Balance (including errors and omissions, monetary authorities' reserve transactions)

This conclusion is, however, ambiguous since our "residual capital" account is computed as the sum of capital flows (private and public), errors and omissions, and official reserve variations. Thus, it reflects the total stock variation of foreign assets held - be they in the form of imported foreign securities and other assets or be they accumulated by the Central Bank - rather than the only capital outflows. An alternative method of presentation might be to lump at least part of the errors and omissions as invisibles together with the service account. The following table presents the data used in Fig.4.

	1968	1969	1970	1971	1975	1973	1974	1975
Trade	-148	-281	-1031	-1136	-1267	-1685	-1148	-71
Transfers	-18	-76	-770	-777	-864	-670	-704	-166
Subtotal	-166	-357	-1803	-1913	-2131	-2355	-1852	-137
Services	1450	1211	1434	1664	1885	2440	2881	7607
Residual Capital	-145	-434	-70	-80	-270	-280	-170	-2087
of which								
Capital	-145	-434	-70	-80	-270	-280	-170	-2087
Errors and Omissions	145	434	70	80	270	280	170	2087
Subtotal	-	-	-	-	-	-	-	-

Source : International Financial Statistics, May 1975, Aug. 1976

Trade (lines 77aa, 77ab), Transfers (77ae, 77af), Services (77ac, 77ad), Capital (77b, 77c), Errors and Omissions (77d), Monetary Authorities (79).
Millions of U.S. \$.

While this might give a taste of the difficulties involved in analyzing the Swiss foreign exchange market, this graph shows, nevertheless, and quite unambiguously a second point. The service balance has improved enormously since the late sixties having almost quadrupled from 1968 to 1975. The contrary is true for the trade balance, at least until 1974.

Had the world stopped in 1974, the interpretation would have been easy : the growing service income linked to the capital movements in and out of Switzerland has produced an excess supply of foreign exchange, therefore, provoked an appreciation of the Swiss-franc and thus contributed to the continued deterioration of the trade balance. 1975 destroyed this easy story. Nevertheless, it might contain some truth, and a closer look at the different sectors might produce elements for a more complete story.

The service sector data given above do not discriminate between subsectors such as tourism, transports, insurance, banking, etc. We also recall that parts of the errors and omissions accounts may reflect elements which should be contained in the service accounts. Thus, looking at these very service accounts may not provide the information we would like.

We do, however, have data about the banking sector, which can produce a partial answer to the questions raised above, that is, to know how much capital movements are linked to exchange rate developments. If we look at Deposit Money Banks' foreign assets and liabilities ¹⁾ we notice that the balance, which was negative until 1966, had turned into a considerable surplus in the years up to 1975. Service income from abroad had remained quite limited throughout the early sixties. ²⁾ But from 1965 onwards the absolute levels of assets and liabilities grew very fast and had more than quadrupled by 1975. Interest revenue grew proportionately more, roughly about eight times during this ten year period. ³⁾

For the period from 1971 to 1975 we computed a net revenue on foreign banking rising from .6 to 1.3 billion U.S.-dollars using the rather conservative 3 vs 5 % hypothesis, or from 1.0 to 2.2 billion dollars using the 3 % interest differential hypothesis. ⁴⁾

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- 1) Reported in IFS, lines 7a and 7b; cf. original version in Swiss-francs : Schweizerische Nationalbank, Das Schweizerische Bankwesen, Zürich, Orell Füssli, 1958 - ; the reporting of these data is rather approximative as accounting practices were standardized completely only at the end of 1974, cf. IFS, Aug.1976, p. 416, explanatory note to International Liquidity.
 - 2) Possibly not even exceeding 50 million U.S.-dollars in the first half of the sixties. (for computation of revenue cf. footnote 4) On the reliability of published data concerning revenue from Switzerland's position as an international banker cf. ROTH, J.P., Monnaie et politique monétaire en économie ouverte. Reflexions sur le cas de la Suisse, Bern, Herbert Lang, 1975, p. 41.
 - 3) Being derived from the absolute levels rather than only from the excess of assets over liabilities.
 - 4) Our own revenue estimations are computations based on the published stock data applying different combinations of give and take interest rates (i.e. those paid to foreign lenders and those received from foreign borrowers) : 3 vs 5, 8 vs 10, 7 vs 10, were the rates computed. A spread of 2 % or even 3 % between interest paid to foreign depositors and interest received from foreign borrowers did not seem an excessive hypothesis.

Noting the fact that the service balance grew in the same period from 1.6 to 3.6 billion U.S.-dollars, it becomes obvious that the revenue derived from Switzerland's position as international banker played a prominent role in the country's balance of payments.¹⁾

What about the trade balance? While we noted the fact that Switzerland enjoyed a trade surplus in the fourth quarter of 1975²⁾, the belief that the revaluation of the Swiss-franc is supposed to hinder exports and to favor imports is too deeply rooted to be dismissed at the appearance of an awkward event which does not fit into the traditional picture.

If we look at aggregate Swiss imports, our faith in the traditional explanation may be restored again. Fig.5 gives the annual growth rates of values, quantities, and unit prices of aggregate Swiss imports.³⁾ While the first hump in the unit price series for 1969-70 reflects essentially the German-mark revaluation, the second one starting in mid-1973 reflects the worldwide inflationary boom which started after the exchange rate realignment in early 1973 and cumulated in the fantastic primary commodity price boom in 1974.

-
- 1) For our purpose it is irrelevant whether this revenue is shipped home or reinvested on the spot, since we only wish to underscore that income variations linked to capital movements will affect the relevant portfolio decisions and thus are likely to influence the exchange rate also in the longer run.
 - 2) The first quarterly surplus since 1953.
 - 3) Computations based on data published in Monatsstatistik des Aussenhandels der Schweiz, Eidgenössische Oberzolldirektion, Bern, 1968 through 1975

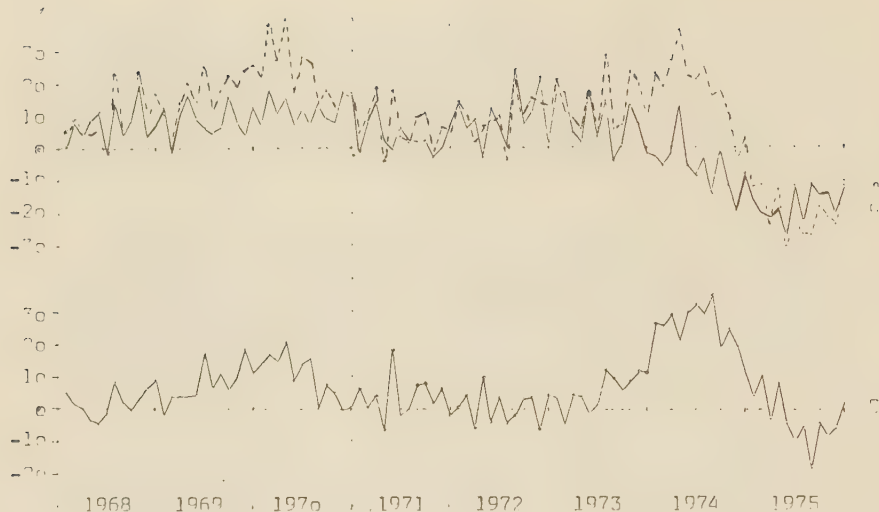


Fig.5 Swiss Aggregate Imports, Annual Variations

A Quantities B Values C Unit Prices

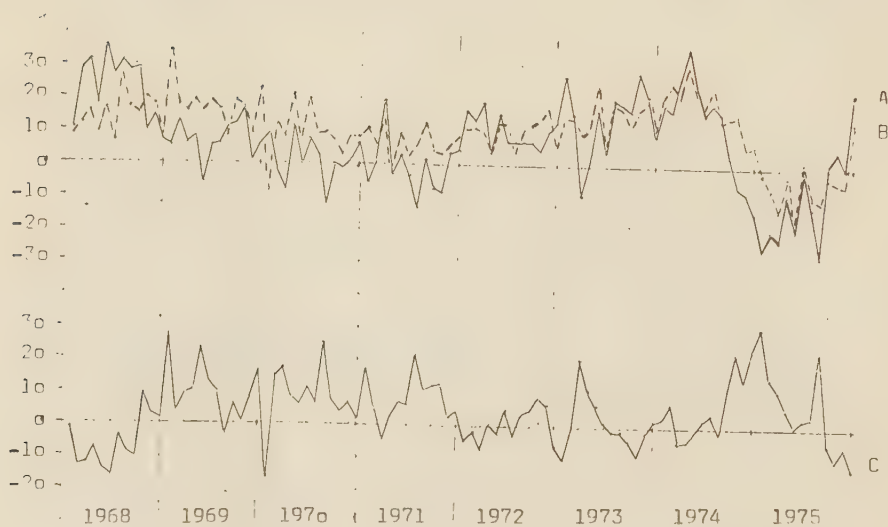


Fig.6 Swiss Aggregate Exports, Annual Variations

A Quantities B Values C Unit Prices

Without too much imagination needed, one could attribute the small growth rates of imports in 1971 to the previous price rise. But the correlation between strongly rising prices and declining quantity growth rates in the 1973-75 period is clearly too obvious to be ignored. It is noteworthy that the quantity growth rates started declining already in 1973 while the value growth rates collapsed only at the end of 1974. Shall we conclude that it took more than one year for quantity variations to exceed price variations and thus, finally, to determine the direction of expenditure changes ?

A look at Fig.6 giving the corresponding annual growth rates for aggregate exports should invite to be a bit more cautious as regards the explanation of complex facts by too simple stories. The general parallelism of the two graphs between 1971 and 1975 suggests that other factors, more important than mere price variations, might have played an important role in trade determination. We may also note that these pictures are average representations of widely differing patterns. In fact, computing similar pictures for various selected countries, we noted considerable differences from case to case suggesting that price variations as well as response patterns might differ from country to country. So much for the service and trade accounts.

c) Some More Data. Exchange Rate Changes and Relative Prices
in Swiss Foreign Trade.

Before concluding this introductory chapter let us introduce some more data material. It will be needed only at some later stage but it may help here to provide a more complete setting for the analysis of the exchange-rate trade relationships which we will undertake in the following chapter.

We have already given the exchange rates of Switzerland's five most important trading partners, that is, Germany, France, Italy, the United Kingdom, and the United States. Together, these five countries provide in 1971 67 % of Swiss imports and absorb 49 % of Swiss exports (65 % and 43 % respectively in 1975).

Imports from these five countries will be the main object of our empirical investigation. In fact, we shall be concerned mainly with the geographical structure of imports and with changes in this structure attributable to changes in internationally relevant prices, particularly to changes in the exchange rates. For this purpose, we shall limit our attention to this small five country world and shall concern ourselves with the shares of imports originating from these countries only. Thus, we notice that in 1971 the 67 % of total Swiss imports coming from these five countries are distributed as follows : Germany 44.2 %, France 18.7 %, Italy 14.7 %, United Kingdom 11.8 %, United States 10.6 % (in 1975 : 42.7 %, 21.2 %, 15.1 %, 9.4 %, 11.6 % respectively). In our computations we shall use the average import shares (measured in value terms) derived from the monthly data from 1968.1 to 1975.12. We shall refer to them as $\bar{w}_i = \bar{IM}_i / \sum \bar{IM}_i$ ($i = D, F, I, UK, US$), the actual data being : Germany 44.05 %, France 19.65 %, Italy 14.42 %, U.K. 10.57 %, U.S. 11.31 %.

Being interested in the structure of imports we shall - as will be outlined in the next chapter - refer rather to quantities than to values. We, therefore, define a new variable $MS_i = Q_i / \sum Q_i$ ($i = D, F, I, UK, US$) where MS stands for import share (in quantity terms) and Q_i is the physical quantity of imports originating in country i .

These import shares will occupy an important place in the empirical part of this paper. It may thus be useful for better visualization to have some graphical representation of these data as well. Fig.7 provides this using the logarithms of the above defined import shares (quarterly data 1968.I to 1975.IV). Notice that the scale is halved for the U.K. and U.S. data.

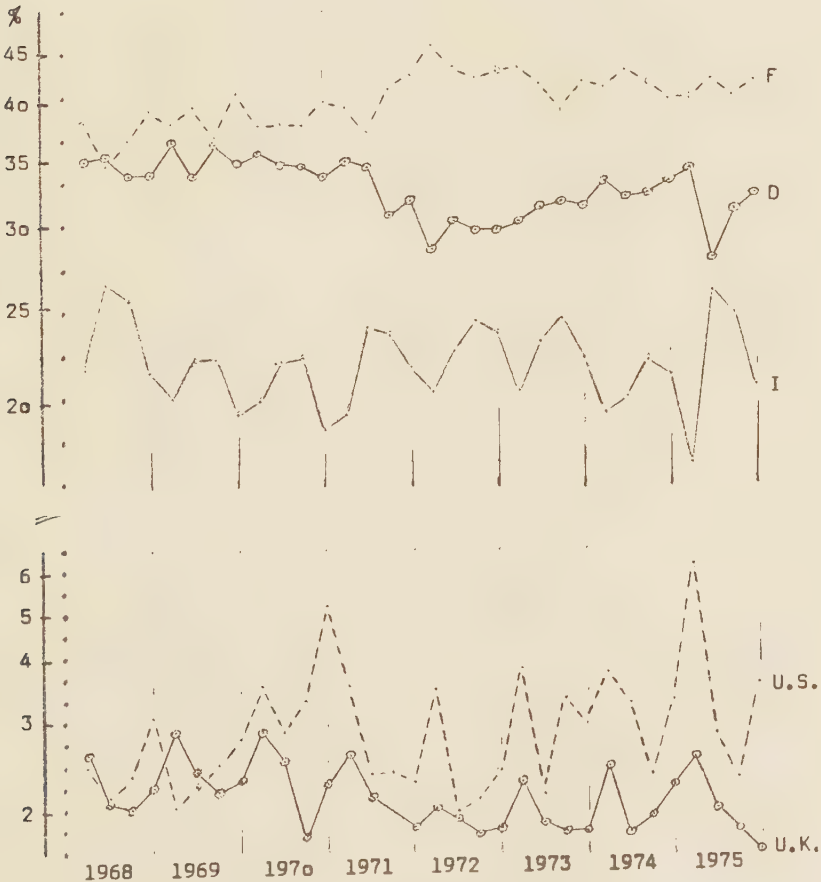


Fig.7 Import Shares (measured in quantity terms)

Visual inspection clearly reveals the cyclical (seasonal) pattern in the Italian, U.K., and U.S. data. It also shows that the U.S.

data, expressed here in logarithms, are the noisiest series among the five we considered in this present exercise.

Another variable which we shall use extensively is defined as EP_i , that is, the price level of country i , P_i (the wholesale price index), expressed in terms of Swiss-francs, E_i being the price in terms of francs of one unit of the currency of country i . We consider this variable as the price levels of tradables in the different countries as seen by the Swiss importers, while UPM_i (the unit price of imports from country i , expressed in Swiss-francs) will be taken to reflect the actually traded goods' prices measured at the Swiss borders.¹⁾ Using EP_i for most of our computations in chapter 3 might appear somewhat paradoxical since we intend to analyze in particular the effects on trade produced by exchange rate changes rather than by changes in the prices of tradables. Technical reasons²⁾, however, do not allow us to separate the two elements determining the price levels of tradables facing the Swiss importers and thus prevent us from providing detailed answers about the respective dynamic response patterns. We are, therefore, led to treat trade responses to changes in wholesale prices exactly identically as to changes in exchange rates. This imposed homogeneity condition makes it desirable to have some better understanding of the relationships between the exchange rates and the combined price variables used in our analysis. The following pages shall provide this, showing that much of the variations of our price variables can be attributed to variations of the exchange rates. We shall also give some evidence with respect to the relationship between our prices of tradables and actually traded goods' prices, thus underlining our argument that the wholesale prices corrected for exchange rate variations can truly be used for the analysis of trade relationships.

1) The import unit prices are shown in Fig.8. These data even more than the import share data presented in Fig.7, clearly reveal the seasonal pattern of our trade series.

2) Essentially lacking degrees of freedom, the period of truly flexible exchange rates being too short to allow a proper analysis of the dynamic response patterns to the exchange rate changes only.

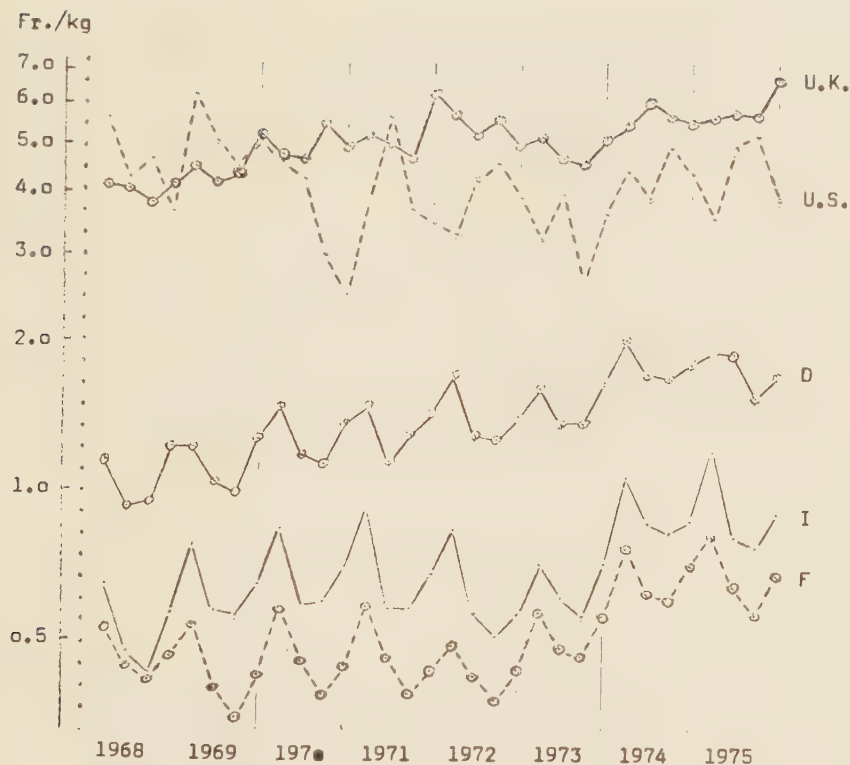


Fig.8 Import Unit Prices

Comparing the graphs of the wholesale prices, P_i (Fig.9), and the wholesale price franc equivalents, EP_i (Fig.10), we notice easily the strong modulating influence the exchange rate variations have had during recent years.¹⁾

If we look at the simple correlation coefficients computed for the whole period 1968.1 to 1975.12 (96 monthly observations)

	LEPD ²⁾	LEPF	LEPI	LEPUK	LEPUS
LP_i	.919	.932	.856	.448	-.116
LE_i	.281	-.799	-.731	-.209	.419

1) cf. also the exchange rate comparison above, Fig.1

2) L in LEP_i etc. stands for logarithm of EP_i , etc.

we get the confirmation that this modulating influence has been strongest in the U.S. and U.K. cases while the French tradables' prices, for instance, seem to have been little affected by these exchange rate variations. If we compare these correlation coefficients with the corresponding data computed for the shorter period 1971.1 to 1975.12

	LEPD	LEPF	LEPI	LEPUK	LEPUS
LP_i	.841	.924	.777	.080	.053
LE_i	-.253	-.730	-.621	.192	-.042

we notice that the dominating influence of the price variations has been reduced in all but the U.S. case, and that in the British case the exchange rate has even assumed the determining role.

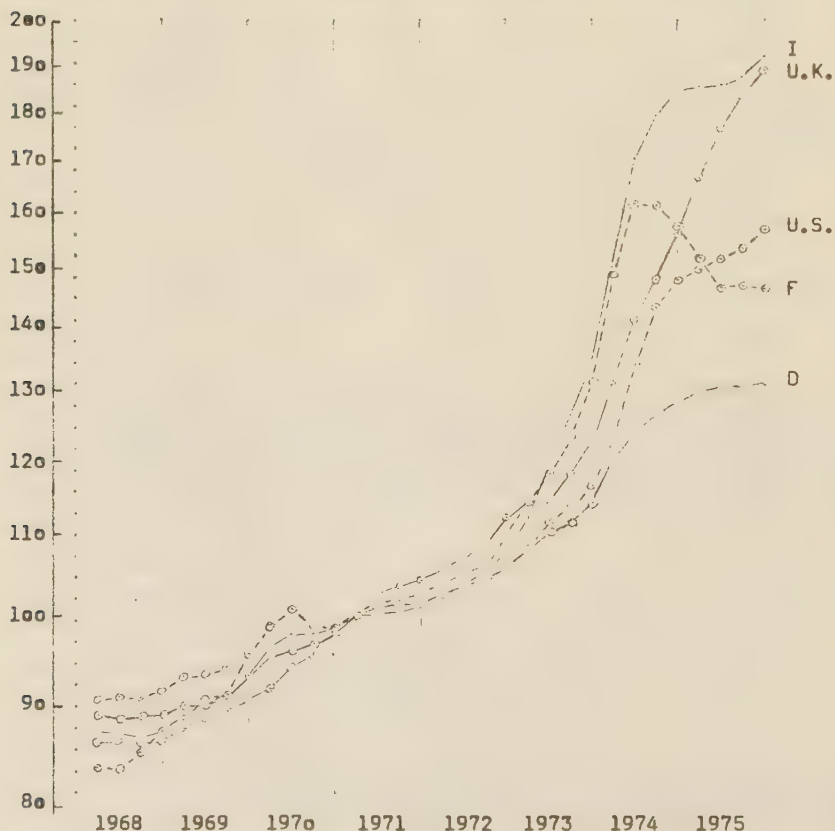


Fig.9 Wholesale Price Indices, 1971.1 = 100

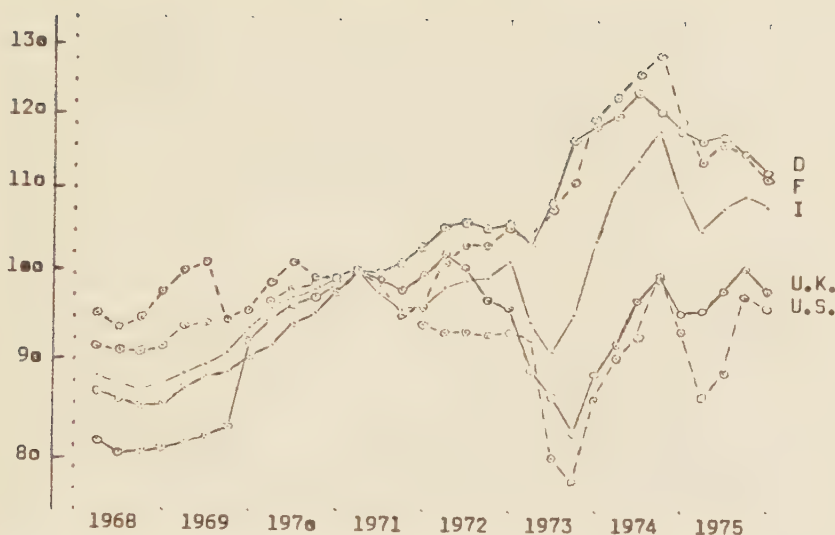


Fig.10 Wholesale Price Franc Equivalents, 1971.I = 100

There is, unfortunately, no obvious method to determine the true influence of one of the elements of such a combined variable on this variable itself, allowing us to state that such and such a fraction of the total variation is due to this element, etc. An approximation method was suggested to us ¹⁾, method based on the recognition that $\sum |\hat{E}P|$ (where $\hat{}$ stands for percentage variation), the sum of the absolute values of the variations of the combined variable, can be decomposed as $\sum |\hat{E}P| = \sum |\hat{E} + \hat{P}| = \sum (\hat{E} + \hat{P})(\text{sign of } \hat{E}P) = \sum (\hat{E})(\text{sign of } \hat{E}P) + \sum (\hat{P})(\text{sign of } \hat{E}P)$. The fraction $\sum (\hat{E})(\text{sign of } \hat{E}P) / \sum |\hat{E}P|$ can thus be taken to reflect the part of the total variation attributable to changes in E. ²⁾

1) by professor H.Genberg

2) We may notice here that this measure tends to overemphasize discrete dominating changes and to ignore small but dominated variations, cf. for illustration the following three examples ; VE stands for variation "explained" by E, the sums indicated are the ones defined above :

Despite the relatively poor characteristics of this approximation, we found the results of our computations sufficiently interesting to be reported in the following table. Our data give the variation "explained" by changes in the exchange rate (in percent). The computations are based on quarterly data 1968.I to 1975.IV.

	D	F	I	U.K.	U.S.
68 - 75 (n = 31)	64.0	30.0	39.6	55.0	75.5
68 - 70 (n = 11)	48.7	22.7	4.8	13.6	13.3
71 - 75 (n = 20)	71.7	33.2	47.4	65.0	83.3
73 - 75 ¹⁾ (n = 11)	67.5	12.0	32.3	27.0	72.2

To put these data in perspective let us add in this following table the corresponding average variations of our combined price variables, that is, $\frac{1}{n} \sum |\hat{E}P|$, expressed as percentage variation per quarter.

	D	F	I	U.K.	U.S.
68 - 75 (n = 31)	2.03	2.71	2.61	2.41	2.78
68 - 70 (n = 11)	1.91	2.34	1.34	1.33	.87
71 - 75 (n = 20)	2.09	2.92	3.31	3.01	3.83
73 - 75 ¹⁾ (n = 11)	2.72	3.67	4.29	3.42	5.23

All these data reflect clearly that the variability of our combined price variables (the wholesale price franc equivalents) increased considerably from the pre-71 period to the mid-seventies. The data also document that an increasing part of this variation can be attributed to the instability of the exchange rates.

Footnote continued :	$\hat{P}_1$	$\hat{E}_1$	$\hat{E}P_1$	$\hat{P}_2$	$\hat{E}_2$	$\hat{E}P_2$	$\hat{P}_3$	$\hat{E}_3$	$\hat{E}P_3$
	+5	+4	+9	+5	0	+5	+5	+4	+9
	+5	+4	+9	+5	+8	+13	+5	+4	+9
	+5	-4	+1	+5	-4	+1	+5	0	+5
	+5	-4	+1	+5	-4	+1	+5	-8	-3
Sums	+20	0	+20	+20	0	+20	+10	+16	+26
	$VE_1 = 0\%$			$VE_2 = 0\%$			$VE_3 = 61.5\%$		

- 1) Excluding the first adjustment reflected in the variation from 1972.IV to 1973.I.

Of course, it is obvious that the exchange rate plays a role in the determination of our index of tradables' prices. So far this is mere tautology and as long as we cannot relate the exchange rate variations to the actually traded goods' prices we have gained little insight into the rationality of our tradables' price index. Since there are no disaggregated import prices available for this purpose, we had to content ourselves with the computation of import unit values. Despite the fact that unit values do not only reflect true changes in prices but also changes in the composition of trade and thus exhibit a strong seasonal pattern, they are the best proxy for traded goods' prices with which we can compare our tradables' price indices. Since lead and lag effects as well as long term changes in trade patterns may affect unit value indices we may not be able to find strong harmony between the different series. Nevertheless, it is quite plausible that the true price variation should dominate - at least in the interrump, the time span we are interested in.

Actually we found the following simple correlation coefficients between the wholesale price franc equivalents and the corresponding import unit values (monthly data)

	LEPD	LEPF	LEPI	LEPUK	LEPUS
LUPM _i (68.1-75.12)	.822	.686	.604	.642	.183
LUPM _i (71.1-75.12)	.663	.646	.544	.415	.361

While these data do not prove the rationality of our tradables' price indices, they certainly do not invite to disregard them.

To get a clearer idea of the relationship between the different series we ran regression equations of the form

$$LUPM_i = a_1 LE_i + a_2 LP_i + \text{constant} + \text{dummies}.$$

The results are contained in the following table (t-values are given in brackets ; the data cover the period 1968.1 to 1975.12, that is 96 monthly observations) :

	LE_i	LP_i	R^2	D.W.
LUPMD	.719 (5.76)	1.400 (27.35)	.9214	1.1688
LUPMF	.028 (.11)	.848 (5.71)	.8973	.9213
LUPMI	.880 (3.32)	1.251 (6.23)	.8358	1.3396
LUPMUK	1.183 (6.07)	1.506 (8.46)	.6642	1.4554
LUPMUS	1.146 (2.55)	1.265 (2.57)	.2563	1.3900

The corresponding results for the period 1971.1 to 1975.12 were (60 observations) :

	LE_i	LP_i	R^2	D.W.
LUPMD	.863 (3.84)	1.534 (12.28)	.8730	1.0248
LUPMF	-.657 (2.35)	.674 (4.31)	.9200	1.1356
LUPMI	.727 (2.29)	1.217 (4.77)	.8569	1.7399
LUPMUK	.981 (3.88)	1.271 (4.97)	.5189	1.4495
LUPMUS	1.456 (3.72)	1.823 (4.35)	.4941	2.1859

We may notice first the relative high R^2 (uncorrected) and the quite high t-values. Despite the generally too low Durbin Watson statistic, we think that these equations can, nevertheless, be taken to reflect reasonably accurately the relationships we are interested in and we thus can attempt to interpret the estimated coefficients.¹⁾

We are, of course, pleased to find all but one coefficients to be positive and these coefficients to be relatively close to unity. In fact, if the unit values would reflect the exchange rate and the wholesale price changes perfectly we would find all coefficients equal to one.

1) There is little alternative except profession of complete ignorance ...

We may notice, however, the interesting fact that the coefficients of LP_i are consistently higher than the coefficients of LE_i . Obviously, the trade unit values measured at the borders reflect foreign price hikes stronger than exchange rate variations. In a period when most prices are continuously rising ¹⁾, but exchange rates move all over the place, the interpretation of this finding may seem obvious : prices seem to be sticky downwards but rather flexible upwards. While the argument "that the wholesale price index reflects also goods which are not strictly speaking tradables, and that traded goods' prices have risen faster than purely domestic goods' prices and this throughout the world" might explain why the LP_i coefficients exceed unity, it certainly does not explain why most of the LE_i coefficients remain below unity.

Whether this apparent price stickiness is due to institutional factors such as, e.g. the use of the Swiss-franc to denominate import contracts ²⁾ or simply reflects unwillingness to pass along easy windfall profits to the final consumer or at least to the importer ³⁾ cannot be determined here. The fact remains that the response of traded goods' prices to exchange rate variations is smaller than the one to changes in the wholesale prices.

While this may have interesting implications for the interpretation of the actual trade response to exchange rate variations, we must keep in mind that our computations will be limited by the imposed homogeneity condition mentioned above, and that interpretations with respect to only one of the elements remain hazardous.

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- 1) Except the French wholesale price which was falling between spring 1974 and the end of 1975.
 - 2) Up to 40 % of import contracts were reported to be denominated in Swiss-francs in 1974, cf. MAYRZEDT, H., von PLATEN, O., "Verhaltensweisen schweizerischer Unternehmen gegenüber der Wechselkursentwicklung im Jahre 1974", Aussenwirtschaft, June 1975, p.156.
 - 3) cf. e.g. a communiqué by the Touring Club of Switzerland (TCS) on excessive car prices, reported in the Journal de Genève, Aug. 12, 1976, p.7.

To get a better idea of the relationship between our tradables' prices and actually traded goods' prices we ran a few more equations of the form

$$LUPM_i = a_1 LEP_i + \text{constant} + \text{dummies}.$$

The homogeneity condition implicit in this formulation becomes quite clear when we rewrite the equation as

$$LUPM_i = a_1 (LE_i + LP_i) + c + d = a_1 LE_i + a_1 LP_i + c + d.$$

The estimated results were the following

	a) 1968.1 - 1975.12		b) 1971.1 - 1975.12	
	LEP_i	$R^2/D.W.$	LEP_i	$R^2/D.W.$
LUPMD	1.325 (23.42)	.8948 .9033	1.678 (11.90)	.8218 .7744
LUPMF	1.735 (15.43)	.8286 .7334	1.744 (9.88)	.7706 .5758
LUPMI	1.934 (12.69)	.7928 1.1350	2.099 (8.27)	.7620 1.1697
LUPMUK	1.748 (8.23)	.4939 1.0134	1.076 (3.68)	.3376 1.0924
LUPMUS	1.100 (2.48)	.2508 1.3783	1.487 (3.65)	.4394 1.9729

It is clear that the statistical quality of these equations is much poorer than that of the unrestricted equations. However, we are not able for our computations to use the more desirable disaggregated price variables and thus are forced to limit ourselves to the relationships which can meaningfully be analyzed. Whatever the statistical significance of these latest equations, one thing stands out clearly : all LEP_i coefficients exceed unity, some considerably so. The meaning of this can only be one thing : our tradable goods' prices reflect variations in the actually traded goods' prices only partially, in some cases perhaps as little as sixty or even only fifty percent. We should keep this in mind when we attempt to measure the magnitudes rather than only the direction of trade responses to variations in international prices. Elasticity estimates would tend to be overestimated.¹⁾

* * *

1) cf. $LMS = \eta LUPM = \eta \circ LEP$ where $\eta > 1$.

The described situation of the small open economy of Switzerland in the rough waters of international liquidity is the starting point for our present study : the argument that capital movements influence the determination of the exchange rates, and exchange rates in turn determine trade flows has been with us now for quite a while already. This argument has not only theoretical implications, however. Its practical as well as political relevance is quite clear, since it concerns not only potential income transfers but also a possible restructuring of whole sectors of the economy.

While we hoped, initially, to provide answers to several of the questions raised above, we are forced, at present, to limit ourselves to the analysis of just one single, although fundamental, issue : as already stated earlier, we are going to look into the basic relationships between exchange rates and trade. While, admittedly, exports provide the best material to analyze relationships between trade conditions and employment, we shall be constrained, for statistical reasons, to concentrate our efforts on the import sector. We shall, in this context, develop a framework for a meaningful analysis of trade relations, as well as provide some detailed answers as regards the dynamics of Swiss importers' responses to changes in the international price pattern. Finally, in a concluding chapter, we shall attempt to derive some answers to the questions touched upon in this introductory chapter.

II. Relative Prices as a Determinant of Swiss Imports

a) Recent Studies on Swiss Foreign Trade

A number of studies concerning Swiss foreign trade have appeared in recent years. Herriger, Scherer and Sohrmann analyzed the Swiss import demand function for the fixed exchange rate period (until 1970), while Thommen was concerned mainly with the export function and, finally, Zehnder investigated some aspects of international price connections.¹⁾

Herriger's paper clearly stems from the early computer era and his import equations, disaggregated by commodity groups, excel through their simplicity. As Scherer points out in his theoretically well developed paper, this timid approach to multivariate estimation produced considerable overestimations of some of the parameters. But the results, nevertheless, remain interesting. These estimations (annual data 1958 - 1969) represent the most serious attempt we know of to explain Swiss imports sector by sector in a (quasi ?) micro-economic framework.

1) HERRIGER, M., Die Importfunktionen im industriellen Bereich der Schweiz, St.Galler Dissertation Nr.429, Esslingen, Verlag Bechtle, 1971

SCHERER, T., Die Importfunktion der Schweiz, Zürcher Dissertation, Zürich, Juris Druck und Verlag, 1974

SOHRMANN, I., Interdependenzen zwischen Import und Konjunktur, Basler Dissertationsreihe Nr.15, Birsfelden, Leothold Repro, 1974

THOMMEN, A., Interdependenzen zwischen Export und Konjunktur, Basler Dissertationsreihe Nr.13, Basel, Offsetdruck Spitteler, 1973

ZEHNDER, R., Die Stellung der Schweiz im internationalen Preis-zusammenhang, Basler Dissertationsreihe Nr.14, Basel, Offsetdruck Spitteler, 1974

The studies by Sohrmann and Thommen present several econometric investigation methods - including market shares analysis and spectral analysis - applied to the Swiss foreign trade data of the period 1950 - 1971. These studies also contain a large number of regression equations. Unfortunately, the disaggregated import and export demand functions presented are too simplistic to yield results of much interest. The aggregate trade equations contained in these studies are more developed and represent a quite rich inventory of import and export demand functions devised by different authors. The economic interpretation of the estimation results is, however, left to the reader.

Scherer's attempt to investigate the aggregate import demand function of Switzerland on the other hand is an interesting example of the difficulties one may encounter while trying to combine analytical rigor and intellectual honesty with the product of far less than perfect tools. Reporting more than sixty differently specified aggregate import equations (quarterly data 1961 - 1970), he concluded somehow disenchanted that "GNP was most probably the overriding argument as far as the determination of imports is concerned while relative prices may have exerted some - although very limited - influence as well".¹⁾

It is not our purpose here to trace these difficulties to any specific source. It is, however, worthwhile to give some thought to some factors which might have caused such an indeterminate outcome. These reasons will at the same time provide some explanation for the particular approach which is proposed in this paper.

We notice first that both, Herriger and Scherer, assume two sets of exogenous variables to enter the import demand function. On one side there are the variables determining aggregate expenditure such as disposable income, industrial production, and even exports used as a proxy for aggregate demand.²⁾

1) SCHERER, op.cit. pp. 153/4. Very free translation.

2) Exports are thought to be a truly exogenous demand factor determining either the derived (import) demand for inputs, or more globally affecting aggregate demand through an accelerator effect, etc.

The other set of variables are those which determine the proportions of the aggregate expenditure to be spent on domestic and on foreign output. The only truly quantifiable variables in this group are thought to be the relative commodity prices, while factors like trade impediments such as tariffs and quotas, or trade promoting efforts such as propaganda campaigns etc. have to be modelled by using dummies or have simply to be dropped from the analysis.

Herriger uses for his disaggregated (13 commodity groups) equations mainly some industrial activity variable (approximately the total sales value of the specific sector) implicitly assuming that the particularly considered commodities are demanded as industry inputs rather than for final consumption. For a number of products, though not for the aggregate import demand function, he obtains a better fit by using GNP instead.¹⁾

As far as substitutability between domestic and foreign production is concerned, he proposes a curious though not uninteresting equation. Defining domestic absorption of domestic output as total production minus exports, that is $A_j = Y_j - X_j$ (in real terms), he postulates the ratio of imports to domestic absorption to be a function of the relative price of imports ²⁾, that is, $(IM_j/A_j) = f(P_{IMj}/P_j)$ where j stands for the specific sector or commodity group. Given the fact that Y , X , and IM can be regarded as monotonically growing functions of time from 1958 onwards and that imports grow faster than domestic absorption ³⁾, the relative price must decline during the period considered to yield the desired negative elasticity of substitution.

1) HERRIGER, op.cit. p. 204

2) For technical reasons the terms of trade are used as a proxy : there exists no published price index for domestic production on a disaggregated level, cf. HERRIGER, op.cit. p. 144. Traded goods' price indices are based on trade unit values, op.cit. p. 124.

3) Annual data ; exports and imports grow almost twice as fast as industrial production and slightly faster than GNP.

This was - in the aggregate - in fact the case for the terms of trade. Using IFS quarterly data we obtain a time trend showing an average decline of the terms of trade of .36 % per quarter.¹⁾ Had he used import prices deflated by the domestic component of the wholesale price index instead these results would have been reversed. This relative price series shows, for the period considered a very slight positive trend, rising .02 % per quarter.²⁾

This brings us back to the traditional import demand function and the different income and price elasticities contained in the two studies. The income elasticities in Herriger, derived from bivariate regressions are simply ratios of growth rates³⁾, and disregard all other possible influences. The resulting aggregate income elasticity of 1.77 (or rather "production elasticity" since the industrial production index is used as explanatory variable) cannot astonish if we consider the worldwide expansion of trade during the sixties. It is certainly wrong to explain this "import biased" growth by the higher propensity to consume more exotic products said to accompany higher real income. In fact, exports rose even faster during this period clearly indicating the tendency for greater international specialization.

This parallelism of import and export expansion seems to have tricked Scherer into accepting exports (though lagged one period) along with income in his final versions of the aggregate import demand equation.⁴⁾ The high correlation with income almost cer-

1) International Financial Statistics, supplement 1973, pp. 406/9, lines 75x and 74 ; 1961.I to 1971.IV, n = 44. Adding two years before or after does not change the sign of the trend.

2) Idem, lines 75x and 63a. The same holds for annual data.

3) $\ln IM = a_0 + a_1 \ln Y$ implies $a_1 = \frac{dIM/IM}{dY/Y}$ which does not represent the partial elasticity, the only magnitude of analytical interest.

4) SCHERER, op.cit. pp. 155/6

tainly poses collinearity problems as seems to be indicated by the fact that their coefficients appear to be of equal magnitude in this equation, while they differ considerably in the equation over the longer period given for comparison.¹⁾

It might be interesting, in this context, to notice, that no one tried to estimate the import demand elasticity with respect to population growth, a variable which is as legitimate as exports but whose high correlation with GNP may be more obvious.

Finally, let us turn our attention again to the price variables. After all, it is our goal to shed some more light on the specific reaction pattern of our foreign trade as regards changes in exchange rates, or, more general, as regards changes in relative prices.

Among Herriger's equations including also a relative price term, only two price coefficients were estimated significantly different from zero (at the 99 % level of significance). It might be only a curious coincidence but these two equations (food and clothing) are the only ones besides the demand function for watches and jewelry (where a low price elasticity is plausible) where GNP is used rather than the industrial production index as the main argument. It seems quite plausible that prices of industrial inputs which will affect the final sales value only by a very small proportion should not show a strong effect on demand. This will be so much more the case as the international specialization is advanced and the price coefficients reflects only the direct price elasticity rather than the elasticity of substitution of foreign versus domestic inputs. The price elasticity of the aggregate demand function, constructed as a weighted average of estimates for the individual sectors, is given as $-.65$, however.²⁾

1) SCHERER, p. 156 : annual data 1948 - 1970. The correlation between industrial production and exports (quarterly data, 1961.I - 1970.IV, logarithmic form, $n = 40$), e.g., is $.986$.

2) HERRIGER, op.cit. p. 211

The price variables in Scherer's final equations are not significantly different from zero (at the 95 % level of significance). Scherer gives the aggregate price elasticity as $-.2$ (quarterly data 1961 - 1970, $n = 40$) and $-.3$ (annual data 1948 - 1970, $n = 23$). These elasticities are apparently mid-point elasticities since they are not derived from log-linear functions.¹⁾

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- 1) cf. SCHERER, p. 142, footnote 2. His estimates for income elasticity are $.6$ for the shorter period using quarterly data, $.8$ for the period 1948 - 70 using annual data (p. 104). It seems that the equations used for the computation of these elasticities are equations Q23 and J17 on pp. 155/6.
- Notice that for the equation J17, using annual data, the Durbin Watson test statistic is $.9$ for $n = 23$ (number of observations), and $k = 5$ (number of explanatory variables). This implies that autocorrelation of the residuals is most likely considerable and that, therefore, the standard errors of the coefficients are likely to be considerably underestimated. If this bias would not exceed, say some 30 % we still could accept the coefficients but at a correspondingly lower level of confidence. E.g. if a 99 % level of confidence were given by the traditional t-test we might accept the coefficient to lie within the true 95 % confidence interval which is about 30 % wider than the 99 % one.
- Using Johnston's formula to approximate the possible estimation bias (JOHNSTON, J., Econometric Methods, New York, McGraw-Hill, 1972, p. 249) we obtain for $n = 23$ and $\rho = .5$ (coefficient of autocorrelation of residuals) a possible bias of about 3 %, but for $\rho = .9$ this bias can reach almost 40 % if the exogenous variable is autocorrelated at the same degree. Unfortunately, there seems to be no clearcut relationship between the Durbin Watson test statistic and the degree of autocorrelation of the residuals, and we cannot, therefore, really accept estimates to be statistically significant unless they pass this test for autocorrelation of residuals. On this criterion, however, more than half of the over 150 equations contained in Scherer's study would have to be rejected as statistically insignificant.

Among the equations which pass the Durbin Watson test, only 12 equations contain price variables whose coefficients are significantly different from zero at the 95 percent level of confidence. Eight of these coefficients have the positive sign.

To terminate let us just report the probably most successful equation as regards statistical significance and expected sign of coefficients¹⁾

$$Q13) \quad \ln IM = -71 + .6 \ln Y - .01 \ln (P_{IM}/P_{Dom}) + 1.2 \ln X_{t-1}$$

$$R^2 = .96 \quad D.W. = 1.8$$

but it is instructive to consider also its linear counterpart

$$Q24) \quad IM = -161 + .7 Y + 1.3 (P_{IM}/P_{Dom}) + .7 X_{t-1}$$

$$R^2 = .96 \quad D.W. = 2.2$$

These results obviously are inconclusive. While these last two equations clearly should invite some reflection on the theoretical preferability of one functional form versus the other, we find little concern for these questions even in the papers by Sohrmann and Thommen.²⁾ This point is addressed by Scherer; however, not in an overly conclusive form, reflecting the treatment of this question in Leamer and Stern.³⁾ We don't know the proper answer to this question either. But while it seems plausible to compare continuously growing variables in their logarithmic form, comparing essentially their long term growth rates, the inclusion of the time trend in its logarithmic form in such an equation as we find it in Herriger⁴⁾, appears rather strange.

1) SCHERER, op.cit. p. 137, quarterly data 1961.I to 1970.IV, n = 40, all coefficients at the 95 % confidence level.

2) cf. SOHRMANN, op.cit. p. 85, THOMMEN, op.cit. p. 35; they simply compute both versions.

3) SCHERER, op.cit. p. 34 ff, based on LEAMER, E., STERN, R., Quantitative International Economics, Boston, Allyn and Bacon, 1970, pp. 17 ff, 49 ff.

4) HERRIGER, op.cit. p. 206

There appears to be no a priori reason to favor one form or the other as far as price ratios are concerned. Price ratios, such as terms of trade, tend to fluctuate around some equilibrium level rather than to exhibit clear trends. The logarithmic version can not, therefore, be understood as a linearization of a constantly growing variable, but it should, nevertheless, still be able to explain deviations from the trend explained by the other variables. Along these lines of reasoning the logarithmic version of the above equation $IM = f(Y, P, X_{t-1})$ appears to provide a better description of the observed data set than the linear one, a fact which may also be reflected in the better R^2 , the coefficient of multiple correlation.

But given all these equations, one fundamental question remains. The question of the interpretation of the numerical results. As already mentioned above, Herriger's high "income elasticity" seems to reflect to a large extent the steady worldwide expansion of trade as is clearly indicated by a comparison of exports and income which yields an "export elasticity" of equal magnitude. The analytical content of such an elasticity estimate appears to be extremely poor, although from a purely descriptive point of view one might be satisfied with a good fit as indicated by a high correlation coefficient.

b) Pitfalls of Traditional Import Demand Analysis

Let us look shortly at two scenarios which show the pitfalls of the above described methods of analysis. Assume first that we have a small country whose terms of trade are determined in the world markets and which we assume to be constant. Assume also that imports and exports grow at the same rate, due to increased international specialization, removal of trade barriers, etc., while income remains stationary. Obviously, neither prices nor income but only exports will be able to "explain" imports. If we allow income to grow but exclude now exports from our equation, it is clear that income will be able to "explain" imports perfectly while prices still have no effect.

We might, of course, try to estimate net imports instead. But assume that we observe a change in taste in the domestic labor force shifting the active population continuously from the traded goods into the service (e.g. banks) sector. Growing net imports of goods can so perfectly be balanced by growing exports of services. If prices and income remain stable not even exports may help any longer to "explain" imports. But if, e.g. income rises, we will again be able to produce a well fitted "import equation".

These two examples may be sufficient to show the risks implied in using underspecified equations.¹⁾ Unfortunately, the problem can be much worse. While in the two examples the estimated coefficients still turn out to have the expected sign giving at least the appearance of providing some analytically useful results, this need not be the case. If, for instance, income in this last example falls, we end up with a negative income propensity to import and, therefore a negative income elasticity for imports which clearly contradicts economic theory. Nevertheless, such an equation can still be regarded to be a useful description of the given data set, but the coefficients contain much more information than the mere elasticities, though in a somewhat concentrated fashion.

1) cf. JOHNSTON, op.cit. p. 169 : Data and degrees of freedom permitting, one should err on the side of including variables in the regression analysis rather than excluding them.

The problem of such a "concentrated" equation is compounded by the possibility of interdependence of the variables. If in the model $IM = f(Y, P, X)$ - to be estimated by ordinary least squares - say, income is highly correlated with exports, multicollinearity will make it impossible to distinguish the effects due to each variable alone in the equation including both variables. If, on the other hand, the relationship between the endogenous and exogenous variables is not a onesided causal relationship but rather one of mutual determination, e.g. if P is determined by IM , none of the above equations will produce a proper solution anymore. Two endogenous variables in a single equation cannot yield any determinate result. Clearly, we need another equation to obtain analytically useful results. In addition, the correlation between IM and P , implied in their functional relationship, implies correlation between one of the exogenous variables with the error term in the equation $IM = f(Y, P, X)$, violating one of the fundamental assumptions of the ordinary least squares estimation procedures. This, per se, will produce at best biased estimators.¹⁾ In such a situation, a proper solution would be to describe this second relationship by a second equation and to estimate the parameters of the structural equations simultaneously.²⁾

To summarize the foregoing arguments we may try to indicate the conditions which must be fulfilled for any single equation to yield meaningful results. First, all the important variables must be included somehow in the equation. Otherwise their influence may be reflected in the coefficients of (highly) correlated variables to which, perhaps, a theoretical relationship cannot even be established. Second, all variables actually included explicitly in the equation must be (linearly) independent of each other with the obvious exception of the dependent one which is explained by the equation. That is, an equation to be estimated by ordinary least squares must include only predetermined arguments, while still contain all the important elements affecting the dependent variable.

1) JOHNSTON, op.cit. pp. 341 ff, 350 ff.

2) cf. idem chapter 13, pp. 376 ff. An alternative would be to use instrumental variables, cf. pp. 278 - 281.

To take up the example previously used, if in $IM = f(Y, P, X)$ income were a function of exports, that is, $Y = \phi(X)$, the equation can be reduced and imports expressed as a function of prices and exports alone $IM = \psi(P, X)$. It is clear that in this reduced form the coefficient of the X-variable contains the income effect as well as the true export effect, that is, $\frac{dIM}{dX} = \frac{\partial IM}{\partial Y} \frac{dY}{dX} + \frac{\partial IM}{\partial X}$.

The same holds, of course, for all variables which are represented implicitly by P.

So far, it appears that such a reduced form, although raising some problems as far as the interpretation of the coefficients is concerned, nevertheless gives an accurate description of the data set, and that it can, therefore, safely be used for prediction purposes, etc.

Unfortunately, we had to recognize that an aggregate import demand equation, containing income and relative prices as arguments can hardly be considered to be such a reduced form equation. Income which is traditionally used as a proxy for expenditure cannot easily be assumed to be independent of the general price level, nor can the price level be considered unaffected by imports. Linkages between the price level and the real sector through monetary mechanisms appear too well established to be ignored. Thus, it is conceivable that income rises, the relative price of import falls and that still the increase in imports does not occur because people wishing to build up their real cash balances as income grows may reduce their expenditures, etc. While these linkages may be of little importance in the long run, they may be very important in the short run. Since our own concern is with the developments of the last few years and particularly with the relationships between trade and the exchange rates of this period, we are not allowed to ignore these linkages.

With all these arguments in mind, one might still try to justify the single equation method. One could argue that simultaneous determination poses no problem as long as the direct causal dependence can be assumed to be of overriding relative importance. The coefficients might be biased, but probably only very little and in

a way which can be predicted by theoretical reasoning. Collinearity and underspecification may pose problems, but careful choice of variables including the truly most important ones and thorough investigation of correlation coefficients, standard errors, etc., combined with a priori theoretical knowledge should do the trick here as well. While there might be quite a bit of truth in such an argumentation, Scherer's results might reduce our optimism. In addition, it might be of doubtful usefulness to go through all the pain of econometric investigation to end up with some guesstimates based essentially on a priori reasoning rather than on hard data.

To sum up this part of the argument, we may say that it seems implausible that aggregate trade equations can meaningfully be estimated in anything but a general equilibrium framework allowing for mutual interdependence of the variables and providing the framework which permits to identify the effects due to the individual arguments rather than to isolate only the purely descriptive coefficients of a reduced form equation.

Since we are not willing (and most likely not able as well) to produce a meaningful general equilibrium model including the Swiss foreign exchange market, we are left at the moment with the only possibility of investigating relations at a somewhat disaggregated level where the traditional *ceteris paribus* assumptions of the partial equilibrium analysis are more likely to obtain.

If we describe total imports as the sum of all j categories of goods imported from i countries, we can write $IM = \sum_i \sum_j IM_{ij}$ ($i = 1, 2, \dots, n$; $j = 1, 2, \dots, m$). Total imports of the good j can thus be written as $IM_j = \sum_i IM_{ij}$.

The traditional import demand functions were designed to estimate micro-economic relations where such a homogeneous good j was to be the dependent variable. Using aggregate income and the relative commodity price p_j^*/p_j^{dom} (the asterisk standing for the foreign world) as arguments, the simultaneity bias may appear to be negligible. It is still, however, not very plausible that such an equation is sufficiently specified. In fact, unless we think about good j as a final consumer good, facing competition of a domestic

substitute (whose price for some obscure reason may differ from the world price), the above equation can only provide a very poor description of the actual demand relationship. If, on the other hand, good j is an input into the production of several final goods destined perhaps for the domestic as well as for the export market, the demand relationship becomes considerably more complicated and we are unlikely to produce accurate and meaningful estimates unless we investigate the complete transformation process as well as the final demand determinants.

It is, however, clear that the truly homogeneous good j , whose world price is P_j^* , does not exist in the actual world. Goods comprised in a single category in the trade statistics may vary enormously in quality and value and this along geographical lines as well as "horizontally" in the form of different subdivisions of individual categories. Thus, cars from Japan or Poland may not be strictly comparable with cars from the United States. Since there exists no proper domestic competition either, the relative price variable in such an equation would measure only the direct price elasticity rather than the elasticity of substitution between comparable foreign and domestic goods. Tracing the effects of exchange rate variations would be so much harder.

Recognizing the basic fact that the goods j originating in different countries may not be perfect substitutes - at least in the short run - and that, therefore, their prices might differ at least temporarily, we might express the world price level of the good category j as the weighted average of all the individual countries' prices, that is $P_j^* = \sum w_i P_{ij}$. Such an expression makes sense only if all prices are expressed in terms of the same currency. We shall write them in terms of our home currency, corrected for the exchange rates, as $P_j^*(Fr) = \sum w_i E_i P_{ij}^*$ where the E_i 's are the respective exchange rates. Since we are interested in these prices only as arguments of our import demand function, we may choose most appropriately some trade or, more specifically, import share measure as weights w_i .

The typical import demand function for good j would thus take approximately the form

$$IM_j = \sum_i IM_{ij} = f(Y; (\sum_i w_i E_i P_{ij}^*) / P_j^{dom}; \dots).$$

This is pretty much the approach followed by Herriger as well as by many others who investigated disaggregated import equations.¹⁾ Since we are interested in tracing the effects of exchange rate changes we may, of course, differentiate the estimated equation with respect to any desired exchange rate to obtain something like

$$\frac{dIM_j}{dE_i} = \left(\frac{\partial IM_j}{\partial (P_j^* / P_j^{dom})} \right) \left(\frac{w_i P_{ij}^*}{P_j^{dom}} \right) \quad \text{this last fraction being the}$$

partial derivative of the relative price variable with respect to the exchange rate.

Besides the fact that this method is overly cumbersome, it is not very clear what question is answered by the above derivative. While we pretend to measure the elasticity of substitution of the rest-of-the-world products versus the domestic direct substitute along with something called the direct price elasticity, we are in fact capturing also all the possible substitution of this imported good j by goods of other categories. It is not very clear whether such an exchange rate effect could catch anything of interest for balance of payments analysis, since it can reflect true import variations as well as mere shifts among different categories of goods.

One other question merits some further consideration before we proceed further. We have refused earlier the single equation estimation of aggregate import demand functions on the ground of interdependence of dependent and "exogenous" variables and stated that the partial equilibrium approach is likely to yield proper results only for disaggregated trade relations. The obvious question to be asked is, of course, how much disaggregation is required?

1) cf. e.g. a list of 200 commodity models, several of which treat import demand functions explicitly in LABYS, W.C., HUNKELER, J., Survey of Commodity Demand and Supply Elasticities, UNCTAD Research Memorandum No.48, 1974.

Herriger's 13 commodity groups, for instance, range from a little over one percent to almost 30 percent in terms of import shares.¹⁾ Should one relate the magnitude of imports of good j rather to the total volume of GNP to get a better idea of the likelihood of interdependence? One might argue as well that even a marginal variation of imports of the good j may affect the domestic price of that good, etc. We don't know the answer to this question, however, and can only hope that biases due to such possible dependence may truly be considered negligible.

1) HERRIGER, op.cit. p. 152, import shares in value terms.

c) An Alternative Solution

If we think that aggregates, perhaps up to fifty percent of total imports, can be treated in a partial equilibrium framework, why should we follow the traditional approach of aggregating only by commodity groups ? This type of aggregation - as has been argued above - is anyhow not likely to provide any useful answers as far as balance of payments analysis is concerned. While we might get some answer how a specific exchange rate change might affect the imports of a specific product, this answer would not provide any indication about the effect of such an exchange rate change on aggregate imports, let alone on the level of absorption.

For these reasons, we propose to disaggregate imports "vertically", that is, along geographical lines rather than by commodity groups. It is clear that the fiction of a homogeneous good with a unique price can no longer be assumed to describe even approximately the bundle of goods imported from a given country. Treating such a heterogeneous group of products as a composite commodity, obviously, is a quite hazardous approximation, but it is, probably, not less legitimate than the traditional type of aggregation. Besides the fact that the exchange rate truly applies to all products imported from a country *i*, we may notice the fact that trade unit values tend to show some geographical patterns as well : Data contained in the United Nations Commodity Trade Statistics show this tendency quite clearly : Among the 16 most important commodity groups for which comparable trade unit values could be computed ¹⁾ we can rank the five main trading partners of Switzerland as follows : Imports from the United States show the highest unit values (24 out of 29 comparable observations in 1970 and 1971), followed by the United Kingdom, Germany, France, and Italy.²⁾

1) These commodity groups are the SITC categories where Swiss imports exceeded 100 million U.S.-dollars in 1971 and where volumes are given in the statistics. The SITC categories included are : 051, 332, 512, 581, 673, 674, 682, 714, 718, 719, 722, 724, 729, 732, 841, 861.

2) The results of this comparison are given in the following table
./.

This nice picture, obviously, appears quite blurred if we include more countries similar to the ones already listed, but the geographical differences remain perceptible.¹⁾

In this view, we thus propose to aggregate across all commodity groups and to analyze more closely our import demand function for goods originating in a country i , that is, $IM_i = \sum_j IM_{ij}$. There appears to be no a priori reason why the arguments used to specify this form of aggregation should fundamentally differ from the previous specification. Thus we may write the function for imports from country i as

$$IM_i = \sum_j IM_{ij} = f(Y; P_i/P_{dom}; \dots) .$$

Y is again the income level representing the domestic level of activity, etc. The relative price level, however, needs to be re-interpreted. Since we treat the different products imported from country i as a composite commodity - exactly as we did before with all the goods comprised in a single category - we need an index of the relevant prices of these imports. It appears to be plausible - again as before - to use a weighted average of the prices of all imported goods for this purpose. But this time we aggregate across the commodity groups rather than across geographical dispersion. Thus, we get for the imports from country i a price level indicator which reflects the actual prices facing importers, expressed (again in terms of our domestic currency) as $P_{IMi}(Fr) = P_i(Fr) = E_i P_i^* = E_i \sum_j v_j P_{ij}^*$, where $P_i^* = \sum_j v_j P_{ij}^*$ may be taken to represent the actual price level of imports from country i (the weights v_j being the actual shares in imports of good j).

Footnote continued :

Rank correlation = .66
n = 145

	1 st	2 nd	3 rd	4 th	5 th
1) U.S.	24	3			2
2) U.K.	2	11	10	5	1
3) D	1	8	13	5	2
4) F	2	3	4	11	9
5) I		4	2	8	15

- 1) The above ranking differs slightly from the comparison of total import unit values computed on the basis of the Swiss foreign trade statistics (cf. Fig.8, p. 23), but there, too, the series are clearly distinct from each other throughout the period considered.

But we could also argue that, since we are interested in the possibilities of substitution of products of one country against those of the others, we would preferably use a price index reflecting the price level of tradables rather than only of actually traded products. In this case we might simply use the wholesale price index of country i , WPI_i , as a proxy for P_i^* . This approximation might also make the comparison with the domestic price level, as well as with the P_i^* 's of competing countries easier.¹⁾

Earlier in this paper we criticized the traditional type of trade equation, using as their relative price variable the import price of good j deflated by its domestic counterpart, as inadequately allowing for substitution possibilities. The same would, of course, apply to this last equation if we were to include only the single ratio of prices of country i to the domestic price level. This would be clear nonsense unless we could expect all the prices and exchange rates of the rest of the world to be perfectly stable. Even so, we could not distinguish in our results the effects due to substitution of imports from country i by domestic products on one side, by imports from third countries on the other. We, therefore, have to introduce the price levels of the competing countries - whose products we assume to be substitutes for our imports from country i as well as our own domestic products - as well. We notice that we treat our domestic products not anymore as the only substitutes for IM_i , but just as any other substitute. We, therefore, see no reason why our own price level should be treated differently and may thus write simply

$$IM_i = f(Y; P_i, P_{dom}, P_{\lambda}; \dots) \quad (\text{where } \lambda = 1, 2, \dots, n; \lambda \neq i).$$

1) Equations of this type in linear and log-linear form are contained in the SOHRMANN study, op.cit. pp. 105 f, 195 ff. Using annual data (1950 - 70), Sohrmann dropped the relative price variable, however, (thought not to be significant anyhow) and estimated only income elasticities. These were found to differ quite significantly ranging from .72 for imports from the United States to 1.79 for imports from Austria. There was considerable autocorrelation of residuals in all cases.

Since this method would produce a rather large number of variables we might wish to replace the P_λ 's by some rest-of-the-world price index such as $P_{row} = \sum_{\lambda} w_{\lambda} P_{\lambda}$ where the w_{λ} 's (as the w_i 's before) are the shares of imports ($IM_i / \sum_i IM_i$) and the P_i 's and the P_{λ} 's the import prices expressed in terms of domestic currency.

To summarize these rather lengthy arguments, let us review what we have basically proposed : Since we wish to analyze the effects of exchange rate changes on trade in a partial equilibrium framework we have shifted our attention from the traditional analysis of "homogeneous" commodity groups, whose prices may be linked to a large number of exchange rates (assuming less than perfect markets) to the analysis of rather heterogeneous bundles of goods imported from single countries having in common essentially only the exchange rate. Treating such bundles of goods as a composite commodity may imply, perhaps, overly strong assumptions. But we feel that, at least for the short run analysis which we propose, this might be considered to be a realistic approximation.

Assuming that we can agree so far on the basic approach, we may wish to check the above equation against the criticism raised with regard to the specification of the aggregate import demand functions earlier in this paper. So far we seem to have included all the relevant variables, those determining the aggregate level of expenditure as well as those which determine the distribution of these expenditures toward the different sources of supply. We have argued earlier, however, that price changes cannot really be expected to be the only reasons for trade shifts. Trade cycles can be observed worldwide and they cannot always be traced back on changes in the only income and price variables. The trade contraction which occurred in 1974/75 seemed to have preceded the worldwide recession rather than to be a mere mirror image of movements in the aggregate (world) expenditure. The rapid growth of trade in the sixties, as has already been argued, owes as much to the fast pace of trade liberalization and developments in transportation as to changes in the only income and price variables.¹⁾

1) One might, of course, force the price argument a bit and say, ./.

Sohrmann, having analyzed the cyclical behavior of Swiss imports (using spectral analysis), notes that there are no fundamental differences as regards the length of import cycles for imports from different geographical areas.¹⁾ Only imports from France and from Germany seem to have longer swings. Comparing the cyclical behavior of aggregate imports of the major European countries, the United States, Canada, and Japan, he finds that all these countries appear to exhibit import cycles of similar length as those of Switzerland.²⁾ Unfortunately, we are told nothing about possible lags nor do we get any other explicit information about possible similarities of these cycles except for their length.

It might have been helpful to have some clearer description of these trade cycles. Scherer's remark that the shares of imports from individual countries in overall imports remain relatively stable³⁾ might be interpreted that the cycles mentioned by Sohrmann must be considered to be synchronized. All these arguments remain, however, terribly vague. On merely theoretical grounds it is quite plausible that imports from different areas should be basically synchronized, at least as long as we assume the domestic business climate to be the main determining factor of imports. It seems quite plausible that variations in the aggregate import demand should not affect the composition of imports nor, therefore, the geographical structure of trade in any significant way. Trade cycles which find their

Footnote continued : ... that trade expanded in the sixties because diminishing transport costs, tariffs, etc. made importables more competitive. Those products thus got a larger market share without their prices necessarily falling much. The most recent recession might be interpreted as being a reaction to the primary commodities' price boom in 1972/73 and the accompanying worldwide monetary instability, making tradables less attractive on the world scene, and effectively reducing the size of individual markets.

1) SOHRMANN, op.cit. p. 164

2) *ibid*, pp. 116, 165; see also graphs pp. 199 ff.

3) SCHERER, op.cit. p.13

reasons not within our own importing country, but which are due to international disturbances affecting international trade channels, are synchronized by their very nature and can be expected to affect the trade of most countries in a similar way. Unfortunately, these questions may not be determined here and have to remain, for the time being, pure assumptions. But unless we find a method for specifying such business cycles properly, we may not be able to disentangle their effects on trade from those due to variations in income or relative prices - at least as long as we hold on to a form of the import demand function like the one given above.

One way to eliminate the cycles which are truly international, and which at the same time allows a better analysis of trade shifts which are due to changes in competitiveness, is to measure import shares rather than imports from a given country in absolute terms. If the assumptions that, changes in the import structure are determined to a large extent by changes in the relative competitiveness, and that this relative competitiveness - at least in the short run - is reflected by the relative price level, hold any truth, then an equation relating the shares of imports from country i in overall imports to the relative price of these imports as compared to the world price level must produce estimates of the elasticities of substitution which can provide insights into some macro-economic relationships as well. The dependent variable $IM_i / \sum IM_i$ in the proposed equation has the advantage of eliminating trends and trend variations which are common to all imports. What remains to be explained are, therefore, only the deviations from the common trend : in fact, the changes in the structure of imports.

It is certainly not very reasonable to expect the prices to be the only variables which could affect the trade structure.¹⁾ Changes in transport technology, or simply organizational variations reflecting the different movements of economic integration in Europe, for instance, could affect trade patterns without being reflected necessarily in prices. In this respect we may draw some

1) cf. criticism above with respect to the assumption that income might be the only variable explaining the absolute volume of trade.

interesting information from Sohrmann's fourth type of trade analysis investigating changes in concentration of imports by regions and by products. In fact, he shows that the geographical structure was varying quite strongly in the fifties and early sixties while it tended to remain stationary in the second half of the sixties, possibly reflecting the end of the trade adjustments induced by the establishment of the European free trade areas.¹⁾ The structure of imports by commodity groups was found to be quite stable during the sixties.²⁾

We don't know of any factor which might have affected the geographical structure of imports in the last few years which could be considered to be of comparable magnitude as the variations in relative prices. Price variations have in fact been considerable ever after the beginning of the monetary instability in 1971. But already in the late sixties, several exchange rate variations occurred after a relatively stable period - exchange rate changes which may have altered not only the relative prices of the currencies concerned but truly the relative prices of the different national outputs.

As before for the import equations, we may use P_i and P_λ as arguments. And again, to reduce the number of variables, we may replace the P_λ 's by $P_{row} = \sum_{\lambda} w_{\lambda} P_{\lambda}$. One might argue that, since we are trying to explain the ratio of imports from country i to overall imports, we might as well use the ratio of the corresponding prices, that is, $P_i / \sum_{\lambda} w_{\lambda} P_{\lambda}$. These ratios, reflecting the competitive position of the different countries, have the same advantages over the absolute values of these prices as those outlined above for the use of import shares rather than imports in absolute terms: trends and trend variations common to all series are ignored and we thus are able to measure deviations from the common trend in terms of deviations from the trend in prices.

1) SOHRMANN, op.cit. pp. 153 ff, and tables pp. 237 ff.

2) *ibid*, pp. 159 ff, and tables pp. 250 ff; the use of data in nominal terms (cf. p. 130) may be adequate for the fixed exchange rate period.

We thus propose to retain for the empirical investigation an equation of the following form

$$w_i = \frac{IM_i}{\sum_i IM_i} = f\left(\frac{P_1}{\sum_i w_i P_i}; \dots, \frac{P_n}{\sum_i w_i P_i}\right).$$

So far, we have defined all variables contained in the above equation except w_i . We have simply stated that it is the ratio of imports from country i to overall imports. But we haven't yet discussed the question whether this ratio should be based on quantities rather than values of imports.

In general, it is not very interesting to relate variations in import values to variations in prices. The value of imports $V = PQ$ contains the two arguments P and Q . Estimating an equation of the form $V = f(P)$ thus can give the linear equation $PQ = a_0 + a_1 P$ which is equivalent to $Q = b_0 + b_1 P^{-1}$, or the log-linear version $\ln P + \ln Q = A_0 + a_1 \ln P$ equivalent to $\ln Q = A_0 + (a_1 - 1) \ln P$. In fact, we are estimating the only interesting relationship, that is, $Q = f(P)$. Although the relationship between the import shares and the relative prices of imports, containing only dimensionless variables, is of a slightly different nature we are interested in capturing the truly behavioral relationships between prices and quantities rather than a combination of effects including some purely definitional elements. We shall use, therefore, the ratio of quantities imported from country i to the total volume (quantity) of imports as our dependant variable.¹⁾

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- 1) It has been maintained that it is impossible or rather meaningless to aggregate quantities of different commodities, say cheese and computers. Although this is a serious problem, we should be aware of the fact that this problem is fundamental to every type of aggregation. It is clear that, e.g., a ten percent variation in the volume of imports due to a change in imports of cheese has quite different value implications than a change in computer imports. Also, a shift from cheese towards computers, maintaining the import value constant, might be interpreted as a trade contraction due to higher prices since the trade unit values would rise. It is for these reasons that we are going to

But can this ratio also provide the proper weights for our world price level $\sum w_i P_i$? It seems plausible to relate the importance of the price level of a country i rather to the total value than to the physical quantity of imports. The share of overall expenditure on imports spent on the imports from country i , $P_i Q_i / \sum P_i Q_i$, is most likely a better measure for the weights P_i should assume in the computation of the overall import price index than the pure quantity share $Q_i / \sum Q_i$. Our equation can thus, finally, be written as

$$\frac{Q_i}{\sum Q_i} = f\left(\frac{P_1}{\sum w_i P_i}, \dots, \frac{P_n}{\sum w_i P_i}\right) \quad \text{where } w_i = \frac{Q_i P_i}{\sum Q_i P_i}$$

and where P_i , the import price equals $E_i P_i^*$, the foreign price level adjusted by the exchange rate.

Footnote continued : ... use only the very large aggregates of the trade flows from and to the most important trading partners. In addition, we assume that the composition of the trade basket remains reasonably stable for each country considered, with the only exception of the seasonal variations which will be dealt with later. That is, we assume implicitly, that an exchange rate change, changing the relative price level of the given national output, will induce equiproportionate trade changes in all commodities or, equivalently, only changes in the "typical products". As stated earlier, we do not think that this treatment of imports from a given country as a composite commodity does imply intolerably bold assumptions, at least as far as the short run analysis is concerned. The theoretically more proper way of analyzing homogeneous commodities in the above proposed framework is unpracticable. While we might be able to single out a few final consumer goods which could be considered sufficiently homogeneous and for which realistic import shares could be compared with the respective trade unit values, we are incapable of producing the corresponding domestic price series for the different countries nor are we in a position to analyze realistically the different substitution possibilities. Also, we could not assume any longer that the trade organization be indifferent to the particular trade behavior as we are able to do in the aggregate.

Two questions remain to be answered before we can attempt the statistical analysis. Until now we have assumed that the conjunctural developments in the different countries were synchronized so that differences in developments of demand or supply conditions could be considered negligible or amply reflected by the variations in prices. While we can imagine "relative activity" variables such as $Y_i / \sum_i Y_i$ to catch effects of this sort, they are unlikely to yield interesting results in the present context unless these variations can be shown to be considerable.¹⁾

The second question relates to the seasonal character of trade. The seasonal pattern of Swiss foreign trade is clearly visible from any graphical representation, at least in the aggregates. This is true not only for the values of imports and exports, but also for the quantities and trade unit values. The spectral analysis exercises by Sohrmann and Thommen document the 12 months cycle also for the geographically disaggregated series, for imports as well as for exports.²⁾ The fact that the trade unit values show seasonal patterns as well is a clear indication that the composition of trade varies through the year. Despite the fact that this pattern might not be repeated perfectly identically every year, it seems plausible that the trade basket be assumed to remain comparable from one year to the other, that is, that the observed differences from one year to the next can be considered to be caused by the exogenous variables contained in the above equations rather than the only variations in the composition of trade.

To eliminate these truly seasonal variations we may simply introduce some shift dummies into our equation, which thus gets its final shape

$$\frac{Q_i}{\sum_i Q_i} = f\left(\frac{P_i}{\sum_i w_i P_i}, \dots; D_1, D_2, \dots\right) .$$

1) A test for differences in business cycles cannot be carried out here. We shall, therefore, in what follows, ignore the possibility that not synchronized business cycles could affect the given trade patterns.

2) cf. SOHRMANN, pp. 109 - 116; THOMMEN, pp. 39 - 43. Cf. also Fig.7 and Fig.8, pp. 21 and 23.

To compare comparables, as well as to limit computation, we include in our empirical analysis only the five most important trading partners of Switzerland. As already stated we are going to use the wholesale prices (WPI), corrected for exchange rate changes, that is $E_i WPI_i = EP_i$, as proxies of the prices of tradables rather than the actual traded goods' prices which we would have to approximate by trade unit values anyhow.

We thus propose to estimate the following import shares equations :

$$\frac{Q_i}{\sum_i Q_i} = f \left(\frac{EP_i}{\sum_i w_i EP_i} ; \text{Dummies} \right) \quad (\text{where } i = D, F, I, UK, US)$$

which we may simplify to

$$MS_i = f \left(RP_i ; \text{Dummies} \right) \quad (\text{where } RP_i = \frac{EP_i}{\sum_i w_i EP_i})$$

that is, the share of imports from country i , MS_i , measured in terms of quantities, is considered to be a function of the relative prices of all the countries' national outputs, RP_i , using dummies to correct for seasonal differences in the composition of trade.

It should be kept in mind that this equation, as it stands, may have 16 exogenous variables, using monthly data, or 8 if we were to content ourselves with quarterly observations. This does not leave much leeway for the investigation of the dynamics of the adjustment mechanism underlying the assumed relationship and we may be forced in our empirical work to use some considerably simplified versions of the above equation. But this will be the concern of the next chapter.

Up to now, we have essentially dealt with questions related to the determination of imports. While the academic interest in these relationships may justify an extended study, the actual main interest in Switzerland clearly centers on the determination of exports. Obviously, a comprehensive analysis along the above proposed lines might shed some useful light on problems of burning actuality and considerable importance as far as economic policy is concerned. Unfortunately, we cannot propose anything as simple as our above equation for the analysis of exports.

From the above discussion of import relationships to the assumption that all international trade is demand determined is only a small step. In fact, we have scarcely given any consideration to supply conditions and even when referring to exports we spoke about the export demand function. This, clearly, is no accident. The mentioned survey of commodity demand and supply elasticities ¹⁾ lists not a single export supply function but only import demand functions. Export functions of individual countries are specified as import functions of the rest of the world !

Shall we conclude that the international market is a buyers' market ? Such a conclusion would probably be overly hasty, but some theoretical reasoning might help to clarify this question. Switzerland being a rather small country, imports are necessarily spread over a very large group of commodities. In most of these markets, Swiss demand amounts to only a small share of overall trade, and Swiss imports can, therefore, be considered to be determined essentially by the domestic business climate since we can assume the world price level to be given. If exports were as much diversified as imports, they would occupy an equally marginal role in the world markets and we could consider them to be entirely determined by domestic factors.²⁾ The benefits of the international division of labor can only be derived from specialization, however, and it is no wonder that Switzerland's export industry has concentrated on relatively few goods but operates in a market which is no smaller than the whole globe. This specialization and the corresponding development of specific markets for Swiss export products make it hard to think of the small country assumption as being an adequate framework for the analysis of these exports. We thus do not think that the market for Swiss exports, and for the same reasons the exports of any country, can be considered a true sellers' market.³⁾

1) cf. p. 46

2) Assuming perfectly elastic world demand for Swiss exports.

3) cf. J.ROBINSON : "The capitalist world (except in rare moments of strong boom) is a buyer's market", in "The Need for a Reconsideration of the Theory of International Trade", in CONNOLLY, M. B., SWOBODA, A.K., eds., International Trade and Money, London, George Allen and Unwin Ltd., 1973, p. 16

The implications of this for our present study are straight forward : In order to use the above proposed analytical framework, we would have to analyze the import demand patterns of all the important trading partners of Switzerland. This is a task, which, obviously, exceeds the data gathering and computing capacities of an individual researcher and which, therefore, may better be left to some larger research organization.¹⁾

We shall, therefore, in what follows concentrate on the analysis of the Swiss aggregate import behavior. But the analytical value of our findings may certainly be extended, at least in part, to the export sector as well. After all, as far as imports are concerned, most countries are small and may, therefore, exhibit an import behavior similar to the one analyzed in the present study.

1) A step in this direction is a study published by H.SIEBER, "Wechselkurse, Rezession und Exportwirtschaft" in Aussenwirtschaft, Dec. 1975, pp. 301 - 328. Unfortunately, much of this study is done using values rather than quantities making thus much of the findings somewhat tautological (as recognized by the author cf. p. 313). That the oil price hike should reduce the Swiss share (in value terms) in the imports of most developed countries can hardly astonish. This does not yet imply that Swiss exports to these countries have actually declined. It would be desirable to limit this import share analysis to the most important effectively competing countries rather than include such specialized countries as the oil exporting ones. Comparing Swiss exports of fall 1974 with those of spring 1975 and reporting a fall in exports is not very helpful either since this seasonal variation has been with us at least since 1967 as far as aggregate Swiss exports are concerned.

III. Empirical Results : Import Shares as a Function of Relative Prices

a) Some Preliminary Results : Static Analysis, Causality

Since we wished to explain import shares as a function of the different price levels of the competing foreign trading partners, we thought it would be useful to include all the relevant five price levels in our equations in order to distinguish the influence due to each individually rather than to obtain only a combined answer as would be obtained by using a simple price ratio such as $P_i / \sum P_{\text{others}}$. We also thought it more reasonable to explain import ratios by ratios of import prices, thus explaining deviations from the common trend in imports in terms of deviations from the common trend in import prices. There seems to be no doubt about the rationality of comparing $Q_i / \sum Q_i$ with $P_i / \sum w_i P_i$, where the Q_i 's are the quantities imported from country i , the P_i 's are the price level of this country, and $\sum w_i P_i$ represents the perceived world level as seen by the importers, the w_i 's being weights commensurate with the psychological importance of country i 's price level - here assumed to be equal to the import share, measured in nominal terms, $\frac{P_i Q_i}{\sum P_i Q_i}$.¹⁾

A problem appears, however, when we introduce more than one, or even all of these five price ratios. It is clear that these price ratios can no longer be considered to be completely independent variables, as was possible when using the absolute values of import prices. Since we have now a definitional relationship between these price ratios - one becoming necessarily smaller when another increases - we may not be able any longer to interpret the coefficients of these relative prices as strictly reflecting the influence of

1) We may notice here that - ceteris paribus - this formulation of the price ratio overemphasizes the price variation of the countries with smaller weights : e.g. a 10 % increase in P_i produces approximately a $(1-w_i)10$ % increase in the own relative price, while all other relative prices decrease approximately by w_i %. Later on, we shall use a less restrictive formulation of our price variables.

these prices. This same definitional relationship holds, however, for the import shares which we try to explain as well. It seems, therefore, nevertheless legitimate to explain import shares in terms of these relative prices or to put it in the form used above: to measure deviations from the common trend in imports by deviations from the common trend in prices.

For our first runs on the computer we thus included all five relative price series as explanatory variables, using the actual import shares (in value terms : $w_i = P_i Q_i / \sum P_i Q_i$) as weights for the computation of the "world" price level. This enabled us to include all five relative prices since the variable weights made these series linearly independent.¹⁾ The following table presents the estimation results of the logarithmic version of these equations. The data cover the period 1968.1 to 1975.12, that is 96 monthly observations. All equations are estimated with constant and seasonal dummies.

Dep. Var.	LRPD	LRPF	LRPI	LRPUK	LRPUS	R ² /D.W.
LMSD	.400 (.404)	-.092 (.170)	.041 (.130)	-1.392 (4.774)	1.354 (3.702)	.4449 1.3899
LMSF	-.663 (.729)	-.236 (.474)	-.064 (.219)	.859 (3.206)	-1.061 (3.156)	.3941 1.2102
LMSI	-2.313 (1.520)	-.621 (.744)	-.734 (1.515)	.454 (1.012)	-.957 (1.701)	.4755 1.5112
LMSUK	1.880 (.907)	.704 (.620)	.117 (.177)	-1.092 (1.791)	1.943 (2.539)	.4999 1.5127
LMSUS	12.778 (3.147)	4.046 (1.818)	3.994 (3.090)	-1.073 (.897)	4.035 (2.689)	.4184 .9874

The R² are corrected for degrees of freedom; t-values are in brackets.

These results are very poor by any standard. Being not quite sure whether part of this poor showing could be attributed to the

1) Collinearity did not seem a serious problem at this stage. The only strong correlations were between RPD and RPUS (-.92) and RPUK and RPUS (.89). All other correlation coefficients were (some considerably) below .80.

use of actual import share weights for the computation of our world price level - introducing additional and unnecessary interdependence into our data matrix - we chose to replace these actual weights, w_i , by their average values, $\bar{w}_i$. This is the intuitively more logical way anyhow since it is unlikely that lead and lag effects, for instance, which might produce strong fluctuations in these weights, should affect the perception of the relative importance of the price series, etc. This method also allows the eventual seasonal dummies to pick up the truly seasonal variations in import shares rather than some obscure combination of quantity and value changes.

Although the simple correlation coefficients are increased only marginally by this change we have now, however, a perfectly singular price matrix. To break the deadlock of linear dependence we may either drop one of the price series (adapting the size of the matrix to its rank) or use, for instance, a logarithmic transformation of the data. The linearly dependent price series cannot be log-linearly dependent since the denominator of the relative prices is the weighted sum of the absolute prices which are the numerators. Earlier in this paper we have slightly touched on the problem of the preferability of using actual data rather than data in their logarithmic form for the purpose of least squares regression analysis. We don't know of any strong criterion which would favor any of the two forms and choose, therefore, for convenience, the logarithmic form which allows us to compare the effects of all prices at once.¹⁾

The first runs using actual data being not strictly comparable, since they do not use the same price matrices, we compared the logarithmic versions of the most naive within-the-period-adjustment equations to detect whether the use of actual import weights for the computation of the "world" price level had a strong modulating influence. The following table contains the results derived from

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- 1) The correlation coefficients show the same pattern as for the actual data. This seems to imply that the two versions are equally well suited for the present analysis.

equations with constant weights, $\bar{w}_i$. The data cover the period 1968.1 to 1975.12, that is 96 monthly observations. All equations are estimated with constant and seasonal dummies.

Dep. Var.	LRPD	LRPF	LRPI	LRPUK	LRPUS	$R^2/D.W.$
LMSD	-8.975 (3.004)	-4.891 (3.189)	-2.246 (2.861)	-3.354 (4.965)	-.984 (1.265)	.5047 1.5513
LMSF	8.119 (2.939)	4.268 (3.010)	2.023 (2.788)	2.663 (4.263)	1.142 (1.588)	.4526 1.2996
LMSI	2.651 (.540)	1.960 (.778)	.221 (.171)	1.335 (1.203)	.339 (.265)	.4657 1.5454
LMSUK	-11.006 (1.686)	-5.923 (1.767)	-2.827 (1.648)	-3.667 (2.484)	-1.315 (.773)	.5134 1.5594
LMSUS	-10.143 (.746)	-7.916 (1.135)	-.125 (.035)	-4.964 (1.616)	-2.011 (.568)	.3619 .9590

The R^2 are corrected for degrees of freedom; t-values are in brackets.

While these equations are not much more successful than the previous ones, they certainly document the "modulating effect" mentioned above. Notice, for instance, that the explanatory power of LRPUS has virtually been wiped out by the elimination of the unnecessary noise in the price data. Despite the fact that a comparison of such "naive" equations may be weak ground to discriminate between the two methods for computing the "world" price level, it seems to support the idea that the elimination of unnecessary noise allows to eliminate some spurious relationships.

Since among all these equations none has a Durbin Watson statistic of even 1.56¹⁾, we can safely assume that all these equations have positively autocorrelated residuals indicating misspecification of the functional form or omission of important explanatory variables. The fact that the present relative prices cannot explain alone the present import shares is, of course, not very much astonishing. We know that many trade contracts precede the actual transactions considerably and we know also that price and exchange rate developments are not always accurately anticipated.

1) 1.56 is the d_L for $k = 5$, $n = 95$ at the 5 % level of significance. Our present k is 17, n is 96.

This leads us to the second part of our empirical investigation which is concerned with the dynamic responses of trade to changes in relative prices.

The first question we may wish to ask is whether the postulated relationship between the relative prices and import shares is really unidirectional as implied in the form of our equation, that is, whether import share changes can be regarded as being caused by the variations in relative prices. If there exists a unidirectional causal relationship between current and past values of the exogenous variables on the one side, the endogenous on the other, we should be able to detect such a unidirectional (not necessarily causal !) relationship using a method proposed by Sims.¹⁾

This method basically consists of regressing the dependent variable on current, past, and future observations of the exogenous variables and then to show that the future exogenous variables have no explanatory power. This test will, however, break down, that is, it will show a two-way relationship, if the endogenous variable is connected to future values of the exogenous variables such as, for instance, by the formation of expectations.

Since serial correlation of residuals - quite common in this type of exercise - makes the usual F-tests inoperable we used the data transformation proposed by Sims, that is, we replaced all the variables $\log x_t$ in our equations by

$$\log x_t(\text{filtered}) = \log x_t - 1.5 \log x_{t-1} + .5625 \log x_{t-2} .^{2)}$$

We also used seasonal dummies as well as a constant. As in Sims, our test concerned only bivariate relationships, that is, we regressed LMS_1 on current, past and future values of the own relative

1) SIMS, C.A., "Money, Income, and Causality", American Economic Review, Sept. 1972, pp. 540 - 552.

2) *ibid*, p.545 : "This filter approximately flattens the spectral density of most economic time-series, and the hope was that regression residuals would be very nearly white noise with this prefiltering."

price variable LRP_i . The following examples for German and French data may illustrate the method. We shall present the equations in tabular form for easier comparison. The equations are of the form $LMS_i = f(LRP_{i,t}; \text{dummies}; \text{constant})$ where t indicates the number of leads or lags.

t	LMSD	LMSD	LMSF	LMSF
+4		.102 (.10)		-.138 (.20)
+3		.321 (.31)		-.065 (.09)
+2		.491 (.48)		-.644 (.89)
+1		.577 (.58)		1.540 (2.12)
0	-.893 (.96)	-.834 (.84)	-.503 (.73)	.165 (.23)
-1	-.077 (.08)	-.147 (.15)	-.840 (1.15)	-.921 (1.28)
-2	-.764 (.80)	-.841 (.84)	.188 (.26)	.472 (.66)
-3	1.559 (1.64)	1.497 (1.47)	-.754 (1.04)	-.894 (1.23)
-4	-.247 (.26)	-.270 (.27)	.105 (.15)	-.071 (.10)
R^{2*}	.2446	.2510	.3163	.3948
D.W.	3.026	3.046	3.128	3.191
$F_{Add}^{1)}$		.134		2.043

The data cover the period 1969.1 to 1975.12, that is, 84 monthly observations. R^{2*} is the uncorrected coefficient of multiple correlation. The critical F-value at the 10 percent level of significance for 4 and 63 degrees of freedom is 2.036. The dummies are significant at the 5 percent level.

- 1) The F-test for the statistical significance of any subgroup of coefficients, here the coefficients for the future values of LRP , is a regular analysis-of-variance test; cf. JOHNSTON, op. cit. pp. 143 - 150.

$$\text{The formula used was } F_{\text{future values}} = \frac{(R^2 - R_R^2)/(k - r)}{(1 - R^2)/(n - k)}$$

where R^2 is the coefficient of multiple correlation of the not-restricted equation (including the future observations of LRP), R_R^2 is the corresponding coefficient of the restricted equation, n is the number of observations, k is the number of exogenous variables in the not-restricted equation (current, past, future LRP 's; constant), r is the number of exogenous variables in the restricted equation (current, past LRP 's; constant).

We did similar exercises - including eight lagged observations of the price variables - for the import data of all five countries. The F-values for the coefficients of the future prices turned out to be rather small. The highest F-value was found in the French case where the future prices could be shown to have some effect (the coefficients being significantly different from zero) at the 18 percent level of significance. We may notice also that - again in the French case - the addition of four future values of the exogenous variable to the basic equation (including the present and four lagged observations of the price variable) produced a larger F_{Add} -value than the addition of four lagged ones.

These results may not seem overly convincing. While they certainly do not rule out a direct relationship between the future values of the relative price variables and the actual import shares, they provide only meager evidence supporting such a hypothesis.¹⁾ With the exception of the French case, a one-way causal relationship from the current and past values of the price variable to the current import share seems to provide a reasonable description of the present data set. In the French case, this hypothesis clearly does not hold : the data seem to reflect a two-way relationship from prices to import shares as well as from import shares to prices. However, as argued at length in some earlier part of this paper, we assume the investigated relationship to be of a truly

1) But cf. the appendix table A.6 on p. 127, where a test similar in spirit to the Sims test is performed. This test, where, instead of the above filter, the coefficient patterns obtained in our iteration approximations are used to eliminate the serial correlation of the residuals, gives additional evidence in favor of the hypothesis that current import shares are linked to future values of the price variables. With the only exception of the U.S. case, the coefficients of the future values of the price variables are shown to be significantly different from zero at the 5 percent level of significance (F-tests for the significance of the coefficients of the future values of the own as well as of the rest-of-the-world prices).

micro-economic character and the price-quantity relationship to be unidirectional. Thus, if we can demonstrate some relationship between future values of the relative price variables and the actual import shares, we have to explain it by expectation and anticipation rather than by a direct mechanistic influence which is the basic underlying assumption of the Sims test.

Before going into more regression exercises, we might go for a short excursion into the world of correlation coefficients. A priori reasoning would lead us to expect negative correlation between the import shares of country i and its corresponding relative price. If we assume some reaction lag we may expect such a negative correlation to obtain at least for lagged values of the price variable and this negative correlation to reach a peak after some periods before falling back somewhere close to zero. If adjustment occurs within the period we might expect the same negative correlation to obtain as well. What about the relationship between the present import share and future relative import prices? Positive correlation seems plausible unless complete lack of foresight were to prevent lead and lag reactions. But we would clearly expect this foresight to be limited quite narrowly in time to only a few periods.

Since the import shares are not independent, having to add up to unity, we may, however, not find all these patterns to obtain. In addition, to get some better picture of these single relationships, we would have to compute partial correlation coefficients rather than only the simple correlation coefficients contained in the following graphs. Nevertheless, this computationally much simpler proceeding may still be of some interest, while the question of the true partial derivatives may better be settled by multiple regression analysis.

Before going into details, let us make some more general remarks. In all these correlation exercises made, we didn't find any coefficient exceeding .60. Since the data contain quite a bit of noise this was not overly astonishing. More surprising was that this noise did not appear to affect these coefficients unduly as is indicated by the relative smoothness of the curves presented in the following graphs. These correlation coefficients may thus be taken to reflect the relative movements in the data trends rather than spurious relationships due to coincidence of strong kicks in these noisy data series. As expected, we do find some peaks, generally only after several periods, followed by continuously decreasing values. This may be taken as an indication that a distributed lag

relationship be the "true" generator of the given data set. We may note, however, too, that the data period covered by these price variables differs considerably according to the number of lags involved. Thus, smaller absolute values of these correlation coefficients for price variables covering more of the fixed exchange rate period might simply reflect the fact that moving import shares are correlated with more stable price series.

Let us look now at the "own price" graph showing the correlation between the LMS_i and the corresponding own price $LRP_{i,t}$ indicating the number of leads or lags of the price variable with respect to the import share variable. The data include 79 monthly observations : LMS_i 1969.2 to 1975.8; $LRP_{i,+4}$ 1969.6 to 1975.12; $LRP_{i,-13}$ 1968.1 to 1974.7.

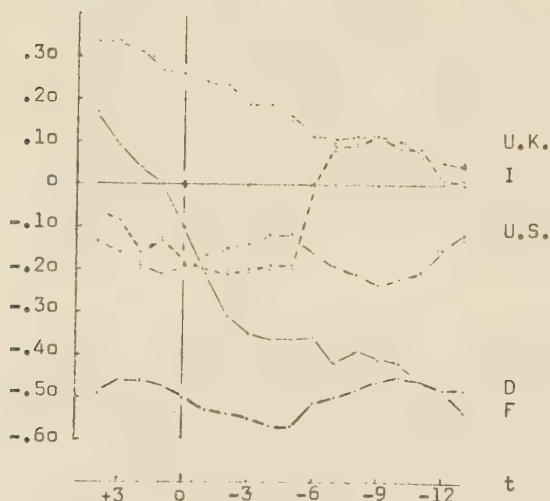


Fig.11 Correlation LMS_i with LRP_i (own price)

As expected (assuming demand to be the overriding factor determining trade flows) we find most price series negatively correlated with the respective import shares. There seem to be, however, two exceptions to the above discussed a priori expectations. The correlation coefficients in the British case turn out to be consis-

tently positive, though fading out as expected. Shall we assume perverse behavior of importers, preeminence of supply conditions, or simply explain it by the dependence of the import share series ? There appears to be no easy answer to this question. The second point concerns the expected positive correlation between the future prices and actual import shares. Despite the fact that most coefficients for these values are a bit more positive or at least less negative only one of the five series seems to behave "properly". The interpretation is not obvious. One could think of a number of ad hoc explanations. But again, we may think of these coefficients as reflecting the more or less strong harmony of the underlying trends in the data and not reflecting the partial derivatives which we are really interested in.

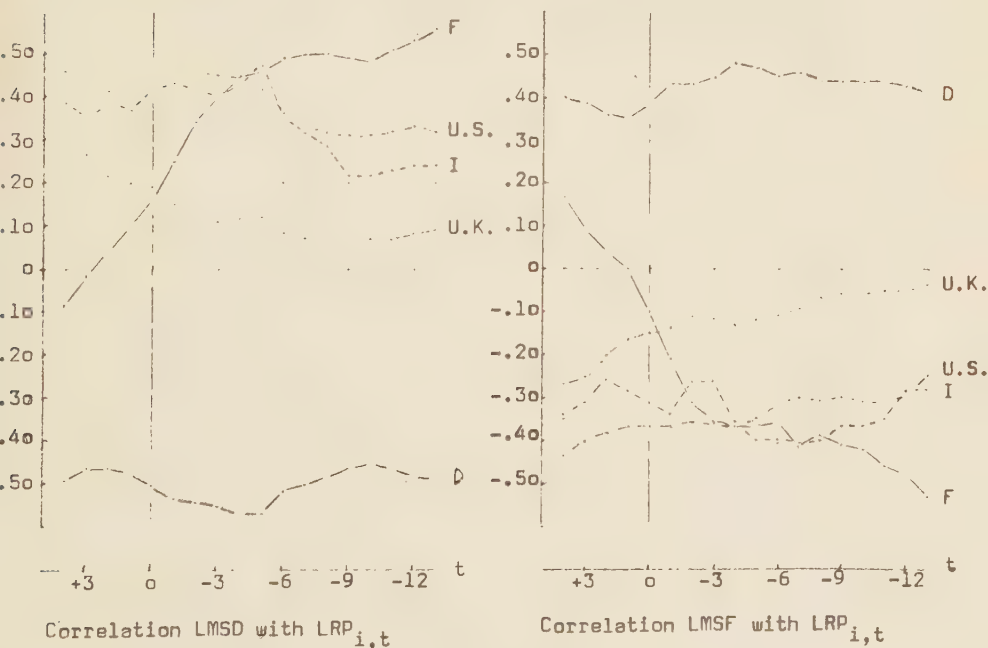


Fig.12 Correlation LMS_i with all LRP_i 's

The same comment clearly applies to the graphs about LMSD versus LRP_i 's and LMSF versus LRP_i 's. While in the graph concerning

imports from Germany all coefficients are "properly behaved" suggesting negative own-price elasticity and positive cross elasticity, this picture looks quite different for LMSF where only LRPD and LRPF behave like expected.

Can these coefficients tell us, after all, anything of interest ? As already mentioned, the fact that peaks do occur in all these correlation coefficient series, and this generally for lags between about 5 and 12 periods (months), seems to support the assumption of a distributed lag response of import shares to variations in the relative prices. It also seems to suggest that the strongest effect is felt only after several periods and that this delay differs from country to country. Thus, peaks for LRPD, for instance, can be found around lags of 5 and 9 periods, the LRPI drops off completely after about 6 periods, while LRPUS shows a small peak for a lag between 9 and 12 periods.

c) Dynamic Response Patterns : Almon-lag versus Koyck-distributed-lag Analysis. Other Methods of Analysis.

After this short excursion let us come back to the multiple regression exercises. We have seen that there are not only theoretical but apparently also empirical reasons to expect a distributed lag relationship from the LRP's to the LMS's to exist. In the following we shall try to investigate the precise nature of this relationship more closely.

Earlier in this chapter, looking into the questions of causality, we found that the high serial correlation of the price variables posed a serious problem of collinearity.¹⁾ Standard errors of coefficients thus become large, but what is worse, coefficients may assume almost any value, positive or negative, depending on the number of variables included and the number of observations used. Clearly, the inclusion of all five price variables lagged several times can produce only very inconclusive results.

How can we get any useful results in this situation ? The simplest method to eliminate this collinearity problem might seem to use a Koyck distributed lag function where besides the current prices also the lagged dependent variable is used as explanatory variable : $LMS_i = f(LRP's, LMS_{i,-1})$. This equation implies some partial adjustment assumption which appears not unreasonable in the present context.²⁾ Besides the purely technical hesitations to use this formula, however, linked to the combined implications of autocorrelated error terms and the use of lagged dependent variables making the traditional test statistics inoperable³⁾, we have other more economically motivated reservations. This formula in fact imposes too strict a weighting pattern assuming a geometrically declining influence of the exogenous on the endogenous variable, assumption which is inconsistent with the idea that the main effect of a price

1) besides the problem of serially correlated error terms, cf. p.65

2) cf. e.g. JOHNSTON, op.cit. pp. 298 ff; LEAMER and STERN, op.cit. pp. 23 ff.

3) cf. JOHNSTON, pp. 304 ff.

change may be felt only after several periods. The fact that this same pattern would be imposed on all the price series without discrimination provides an additional argument for the rejection of this method for the present analysis. The use of some lagged explanatory variables together with the lagged endogenous one, such as $LMS_i = f(LRP_i's, LRP_{i,-1}'s, LRP_{i,-2}'s; LMS_{i,-3})$ to allow the data to determine the initial weight patterns, is inoperable in our context for collinearity reasons.

A more flexible though purely descriptive estimation method is provided by Almon.¹⁾ Based on a polynomial approximation of the "true" reaction pattern, this method allows a relatively generous number of different configurations of the coefficients of the lagged exogenous variables. Its main advantage is to reduce the number of explanatory variables in the equation and thus to reduce the collinearity problem.²⁾ However, the inclusion of several explanatory variables requires a considerable amount of computation as well. As far as the freedom of the data to determine the polynomial approximation is concerned some reservations have to be made, too. A simple polynomial of the second or third degree imposes quite a rigid pattern on the possible coefficient configuration, pattern which may not be confirmed by pure theoretical (economic) reasoning.³⁾ We shall come back to this method of analysis.

Constrained by the above mentioned collinearity problems as well as by the space limitations of the computer program used initially, we finally chose an alternative and simpler method to cut through this mass of data. Imposing some arbitrary weighting patterns on a reduced number of price variables, e.g.

$$LMS_i = a_0 + a_1 LRP_{i,+1} + a_2 (.15 LRP_i + .2 LRP_{i,-1} + .25 LRP_{i,-2} + .2 LRP_{i,-3} + .2 LRP_{i,-4}) ,$$

1) cf. e.g. JOHNSTON, pp.294 ff; LEAMER and STERN, pp. 26 ff.

2) This second point will be qualified later on.

3) Polynomials of higher degrees provide little computational advantage using up too many degrees of freedom. Rounding errors, too, become more important the higher the degree of the polynomial and the larger the number of lags included.

we hoped to determine not only the signs of leading and lagging prices but also, by comparing different weighting combinations, to get some better idea of the "true" pattern of the trade reaction through time. Testing too many hypotheses at once, this rudimentary iteration procedure did not allow us, however, to draw the desired inferences. While we found that, as expected, most past "own" prices showed negative, future "own" prices positive signs - reciprocally for the "rest-of-the-world" prices - we could not discriminate between different reaction patterns.¹⁾ Such a confirmation of the most naive expectations clearly was not satisfactory, since the explanation of the exact pattern of the dynamic trade responses to exchange rate changes is the only justification for this study.

Fortunately, technological improvements together with the availability of new software²⁾ made it possible to pursue our analysis: the easy data handling facilities of the new computer center allowed us to reconsider the investigation technique, and we finally chose to use an extended and refined version of the iteration procedure introduced above. In order not to start with mere guesswork we expected the above discussed Almon-lag technique to provide some initial coefficient pattern. Modifying such an initial pattern, removing step by step some of the rigidities imposed by

1) For equations distinguishing explicitly between own and rest-of-the-world prices we found between 70 and 80 % of all coefficients to correspond to the mentioned expectations (about 400 estimated coefficients; all equations were estimated without seasonal dummies due to space restrictions of the computer program used). A major exception were only estimates related to the imports from the United States. This data series is clearly the noisiest one, the R^2 for these equations never exceeded .13. An interesting point was that the coefficients for the present prices generally had the same sign as future prices. This can relatively easily be explained by the fact that the price variables (i.e. the exchange rate component of it, no other data being available) are end-of-period data, while the import shares are based on flow data covering the whole period.

2) i.e. C.R.WYMER's programs TRANSF and ORLESQ.

the use of a simple polynomial approximation, should then allow us, to approach the underlying "true" coefficient configuration reflecting the "true" behavioral response pattern of international traders.¹⁾

Thus, our first task is to establish some Almon-approximations which can be used as a basis for our iterations. For this purpose we introduce equations of the form

$$\begin{aligned} \text{LMS}_i &= f(\sum_{t=0}^{\infty} v_{i,t}^{\text{LRP}}, \sum_{t=0}^{\infty} v_{\lambda,t}^{\text{LRP}}; \dots) \\ &= (b_0^{\text{LRP}}{}_{i,0} + b_1^{\text{LRP}}{}_{i,1} + \dots + b_t^{\text{LRP}}{}_{i,t}) \\ &\quad + (c_0^{\text{LRP}}{}_{\lambda,0} + c_1^{\text{LRP}}{}_{\lambda,1} + \dots + c_t^{\text{LRP}}{}_{\lambda,t}) \\ &\quad + (\dots) + \text{dummies} + \text{constant} \end{aligned}$$

where t indicates the number of lags of the price variables. These equations can, using the standard Almon transformation²⁾, be written as

$$\begin{aligned} \text{LMS}_i &= a_0^{\text{LRP}}{}_{i,0} + (1^0 a_0 + 1^1 a_1 + \dots + 1^n a_n) \text{LRP}_{i,1} \\ &\quad + (2^0 a_0 + 2^1 a_1 + \dots + 2^n a_n) \text{LRP}_{i,2} \\ &\quad + \dots \\ &\quad + (t^0 a_0 + t^1 a_1 + \dots + t^n a_n) \text{LRP}_{i,t} \\ &\quad + (\dots) + (\dots) + \text{dummies} + \text{constant} \\ &= a_0^{\text{LRP}}{}_{i,0} + a_0 (\text{LRP}_{i,1} + \text{LRP}_{i,2} + \dots + \text{LRP}_{i,t}) \\ &\quad + a_1 (1^1 \text{LRP}_{i,1} + 2^1 \text{LRP}_{i,2} + \dots + t^1 \text{LRP}_{i,t}) \\ &\quad + \dots \\ &\quad + a_n (1^n \text{LRP}_{i,1} + 2^n \text{LRP}_{i,2} + \dots + t^n \text{LRP}_{i,t}) \\ &\quad + (\dots) + (\dots) + \text{dummies} + \text{constant} \\ &= a_0 \sum_{t=0}^{\infty} t^0 \text{LRP}_{i,t} + a_1 \sum_{t=0}^{\infty} t^1 \text{LRP}_{i,t} + \dots + a_n \sum_{t=0}^{\infty} t^n \text{LRP}_{i,t} \end{aligned}$$

with n = the degree of the polynomial approximation, and
 t = the number of lags of the explanatory (price) variable.

1) This iterative procedure will be discussed on pp. 84 ff.

2) cf. JOHNSTON, op.cit. p. 295

Instead of estimating $t+1$ coefficients for each price variable (b_0 through b_t), we reduce the number of explicit (combined) variables to $n+1$ (coefficients a_0 through a_n). It is clear that these combined variables, $\sum_t^n LRP_{i,t}$, whose coefficients, a_n , are to be estimated by ordinary least squares have to satisfy all the underlying assumptions of the OLS estimation technique. It became, however, quickly clear that these combined variables were extremely highly correlated. Collinearity was too obvious to be ignored, and the coefficient patterns computed based on these estimates were assuming the most implausible forms.¹⁾ The b_t coefficients computed as $b_t = \sum_n^n t^n a_n$, are clearly very sensitive to any error in the estimation of the a_n -coefficients. Thus, even small standard deviations of these coefficients may allow a wide variety of "true" b_t patterns. The interpretation of the results in the presence of relatively imprecise estimates is so much more hazardous.

Since we didn't know whether this high degree of collinearity was due only to the character of the estimation technique or also influenced by the linear dependence of our relative prices (mentioned at the beginning of this chapter) we experimented with simpler equations of the form

$$LMS_i = f(\sum_t^n LRP_{i,t}) .$$

We used LMS_i lagged three and four periods as dependent variables and estimated third and fourth degree polynomials for the b_t coefficients including besides the present also nine, ten, and twelve lagged price observations. The results²⁾ were not very satisfactory. Only the equations concerning imports from Germany and from France corresponded somewhat to our a priori expectations discussed earlier, while the results in the U.K. and U.S. cases were clearly contrary to these expectations.

1) Two examples are given in the Appendix, Table A.1

2) Examples of a third degree polynomial approximation of such bivariate relationships are contained in the Appendix, Table A.2

d) Removing Unnecessary Homogeneity Conditions. A General Almon-lag Analysis.

The inclusion of only one relative price variable in our analysis of trade response patterns, as it was done in our last exercises, necessarily introduces undesirable distortions. We had insisted in our earlier discussion on the inclusion of all the relevant price variables into our equation, and this to enable us to take account of all the possible substitution effects and not just to measure some obscure combined effect. While we might have considered the relative price variable, LRP_i , to allow for substitution possibilities since the "world" price was used as deflator of the "own" price, the interpretation of our estimated coefficient patterns is far less than obvious. We must remember that our relative prices contain the numerator as an element of the denominator as well. While this poses no problem as long as all the other relative price variables are included in our regression equation, the inclusion of only one of them imposes rather rigid homogeneity conditions. In fact, the present equations implicitly contain the assumption that a change in the "world" price level is perceived equally well as a change in the specific "own" price and that the trade reaction, therefore, follows exactly the same pattern.

It might be illuminating to rewrite the above equation

$$LMS_i = f(\sum_t v_t LRP_{i,t})$$

as

$$\begin{aligned} LMS_i &= A_0 + a_1 (\sum_t v_t LRP_{i,t}) = A_0 + a_1 (\sum_t v_t L(\frac{EP_{i,t}}{\sum_i \bar{w}_i EP_{i,t}})) \\ &= A_0 + a_1 \sum_t v_t (LEP_{i,t} - L \sum_i \bar{w}_i EP_{i,t}) \\ &= A_0 + a_1 \sum_t v_t LEP_{i,t} - a_1 \sum_t v_t (L \sum_i \bar{w}_i EP_{i,t}) \end{aligned}$$

and we can see clearly that we are compounding the restrictions of the arbitrary weight pattern with the homogeneity condition concerning the respective prices.¹⁾

1) a_1 is a scale factor; $\sum_t v_t$ is the polynomial curve or weight pattern; L stands for logarithm. We shall use the same notation for our iteration approximations.

We may note here, too, that our price variables EP already contain another, similar homogeneity condition since we do not distinguish between changes due to exchange rate variations and the "true" price changes. One can easily overdo the imposition of such restrictions in the search for models which can be handled by the computational means available, but in such a case "bad" results in terms of statistical or, worse, in economic significance may be the price to be paid. Leamer and Stern, discussing a similar case of substitution analysis, give an example of a completely perverse result due to the imposition of such homogeneity conditions.¹⁾ We already have mentioned Herriger's substitution analysis which suffers from the same problem, although his results have, accidentally, the "right" sign.²⁾

Despite the fact that our own equation is not exactly a straight forward substitution equation as the one in Leamer and Stern, we cannot deny the strong similarity and, therefore, the likelihood that our results may be distorted by this imposed restrictions as well. We thus decided to eliminate this implicit homogeneity condition allowing different reaction patterns to be estimated as regards changes in the "own" price versus changes in the "rest-of-the-world" price. This is equivalent to dropping our "relative" price variables.

We do not drop the concept of a relative price completely, however. Returning to an earlier formulation of our basic equation we write now

$$LMS_i = f(LEP_i, LEPROW_i) = f(LEP_i, L \sum_{\lambda} v_{\lambda} EP_{\lambda}).$$

Note that we do not compare the "own" price with the "world" price any more but with the "rest-of-the-world" price, where we impose $\sum_{\lambda} v_{\lambda} = 1.0$, the v_{λ} being defined as

$$v_{\lambda} = \frac{\bar{w}_{\lambda}}{1 - \bar{w}_i} \quad (\text{that is, import shares in value terms}).$$

($i, \lambda = D, F, I, UK, US$; $i \neq \lambda$)

1) LEAMER and STERN, op. cit. p. 61, pp. 72 ff.

2) cf. above pp. 35 f.

The most simple equation of this series thus is

$$LMS_i = a_0 + a_1 LEP_i + a_2 LEPROW_i$$

which can be rewritten as

$$MS_i = A_0 \frac{EP_i^{a_1}}{EPROW_i^{-a_2}} .$$

We estimated again third degree polynomial approximations of the coefficient patterns including three future as well as six, respectively nine lagged observations of the explanatory price variables. This experiment revealed clearly the sensitivity of this particular estimation technique to the number of lags included in the analysis. While the R^2 were little affected by this "stretching of the polynomial", the peaks and troughs were clearly moved downwards toward the coefficients of the price variables lagged more periods. Most of the coefficients were smaller in absolute values with only some marginal exceptions for values at the end points of some of the estimated polynomials. As in all estimations so far, the seasonal dummies were not significant in the German and French cases ¹⁾, while they produced high F-values in the other three cases throughout the computations.

The coefficients contained in the following table are derived from a third degree polynomial approximation of the equation $LMS_i = f(LEP_i, LEPROW_i)$. The data cover the period 1969.1 through 1975.12, that is, 84 monthly observations. The dependent variables are the LMS_i lagged three periods; the explanatory price variables are LEP_i and $LEPROW_i$ lagged zero to twelve periods. Only the equations for Italy, the U.K., and the U.S. contain seasonal dummies. ²⁾ The given test statistics refer to the corresponding Almon-lag equations. The F-test is the one described above.

1) F-values considerably below 2.0 .

2) The estimated coefficients as well as the coefficient patterns including only six past observations of the price variables are contained in the Appendix, table A.3.

Third degree Almon-approximation of trade reaction patterns based on $LMS_{i,-3} = f(LEP_{i,t}, LEPROW_{i,t})$, with $t = +3, +2, \dots, -9$. Data cover the period 1969.1 through 1975.12, that is, $n = 84$.

	Dep. Var.: LMSD	LMSF	LMSI	LMSUK	LMSJG
t					
+3	.282	.294	-.677	1.048	2.284
+2	.141	.155	-.165	.225	.409
+1	.040	.023	.113	-.268	-.684
0	-.028	-.017	.204	-.493	-1.138
-1	-.070	-.061	.156	-.514	-1.106
-2	-.092	-.093	.018	-.393	-.735
-3	-.103	-.090	-.162	-.191	-.174
-4	-.108	-.087	-.337	.029	.428
-5	-.115	-.079	-.457	.205	.920
-6	-.130	-.072	-.477	.274	1.156
-7	-.160	-.071	-.346	.175	.905
-8	-.211	-.091	-.017	-.156	.250
-9	-.292	-.108	.568	-.780	-1.172
LEP _i					
+3	.326	-.324	-.162	-1.587	-.030
+2	.107	-.105	-.104	-.689	-.017
+1	.003	.031	-.046	-.091	.069
0	-.012	.100	.008	.256	.200
-1	.037	.118	.058	.403	.346
-2	.124	.100	.103	.400	.479
-3	.222	.062	.143	.296	.572
-4	.306	.021	.174	.141	.506
-5	.350	-.008	.198	-.013	.523
-6	.328	-.008	.212	-.118	.324
-7	.214	.035	.216	-.123	-.030
-8	-.017	.139	.209	.021	-.565
-9	-.391	.318	.188	.366	-1.311
LEPROW _i					
+3	.326	-.324	-.162	-1.587	-.030
+2	.107	-.105	-.104	-.689	-.017
+1	.003	.031	-.046	-.091	.069
0	-.012	.100	.008	.256	.200
-1	.037	.118	.058	.403	.346
-2	.124	.100	.103	.400	.479
-3	.222	.062	.143	.296	.572
-4	.306	.021	.174	.141	.506
-5	.350	-.008	.198	-.013	.523
-6	.328	-.008	.212	-.118	.324
-7	.214	.035	.216	-.123	-.030
-8	-.017	.139	.209	.021	-.565
-9	-.391	.318	.188	.366	-1.311
R ²	.4871	.2981	.6013	.5358	.4368
D.W.	1.3292	1.3997	2.3128	1.7482	1.0883
F (dummies)			9.4787	5.8133	4.9528

We may notice that the results turned out to be quite satisfactory. The lagged own price shows the expected negative sign, the rest-of-the-world price the positive sign. Even the future prices can be seen, without appealing excessively to imagination, to conform to our a priori expectations.

Some "irregularities" still subsist, however, inviting some ad hoc explanations : longer reaction lags might be due to the effect of geographical distance since goods arriving at the border, where they are registered by the customs authorities, might have been travelling already for several months Standard errors in the

"irregular" equations are particularly large, etc. While these explanation are all correct we should not use this easy way out of the trouble as long as we have not used all means available to extract information from the given data set. After all, the relative size of the standard errors is large for all estimated coefficients as is indicated by the low t-values obtained in all Almon-transformations used. Only about two dozens of the 160 relevant coefficients estimated in this series show t-values exceeding 2.0 and most of them concern the coefficients with the largest standard errors measured in absolute terms. So far we have no choice but to rely on the given point estimates and to consider the computed coefficient patterns as rough approximations of the "true" patterns.

Since we thought that the use of a third degree polynomial approximation might have unduly influenced the location of the peaks and troughs as well as their relative magnitudes, we tried to disaggregate somehow to allow the data to determine the locations of the peaks as well as their magnitudes. For this purpose we rewrote our equation as

$$LMS_i = f(LEP_{i,future}, LEP_{i,past}; LEPROW_{i,future}, LEPROW_{i,past})$$

using for each of the four explanatory variables a quadratic approximation. The results are contained in the following table.¹⁾

But again, collinearity is very much in evidence. Of all the 240 relevant coefficients in this series only six showed a t-value exceeding 2.0. This implies that the above structures have to be considered as rather vague approximations of the "true" patterns. That we find maxima where we expected minima ²⁾, such as in the coefficient pattern for $LEP_{0,past}$, is not overly disturbing as long as the sign is "right", since it might be due simply to the number of lags included in the Almon-approximation. The information this "wrong" form contains about the correct number of lags to be included is, however, extremely vague.

1) The estimated a_n -coefficients are given in the Annexe, table A.4

2) A "T" next to the coefficients in the table indicates a maximum, a "L" indicates a minimum in the estimated pattern.

Second degree Almon-approximation of trade reaction patterns
 based on $LMS_{i,-3} = f(LEP_{i,fut.}, LEP_{i,past}; LEPROW_{i,fut.}, LEPROW_{i,past})$
 with future = +3, +2, +1, 0; past = -1, -2, ..., -9. Data cover the
 period 1969.1 through 1975.12, that is, $n = 84$.

Dep.Var.:		LMSD	LEPGE	LMSI	LMSUK	LMSUS
LEP _i	future					
	+3	.034	.083	-.211	1.794	3.280
	+2	.381 T	.073 L	-.525 L	-.027	-.370
	+1	.000	.000	-.000	-.000 L	-1.468 L
	0	-.000	.000	-.000	-.027	.012
	past					
	-1	-.076	-.400	.053	-.272	-1.747
	-2	-.059	-.296	.099	-.081	-.655
	-3	-.055 T	-.154	-.229	.050	.162
	-4	-.055	-.055	-.470	.119	.701
LEPROW _i	future					
	+3	.592	.027	-.223	-1.787	-.183
	+2	-.100	-.100	.062 T	-1.002	1.563 T
	+1	-.208 L	-.265	-.016	.013	.460
	0	.024	-.337	-.460	2.695	-3.491
	past					
	-1	-.189	.517	.342	-.559	1.685
	-2	.070	.206	.725	-.279	1.290
	-3	.259	.081	.142	-.060	.919
	-4	.361	-.037	.094	.095	.570
	-5	.352 T	-.089 L	.011 L	.188	.243
	-6	.323	-.072	.102	.218 T	.060
	-7	.183	.010	.158	.186	-.340
	-8	-.039	.159	.248	.090	-.598
	-9	-.341	.375	.373	-.068	-.832
R ²		.4777	.3047	.6000	.5455	.4409
D.W.		1.3502	1.4400	1.3496	1.7000	1.1146
F (dummies)				10.1456	6.1758	4.5596

e) Approximation by Iteration

We hoped to use the Almon-lag approximation technique to provide us with some reasonable initial values for an iterative approximation procedure. The results we obtained are, however, far less than clear. While we noticed certain regularities such as generally negative signs for past values of the "own" price, and positive values for the past observations of the competing "rest-of-the-world" price, little can be said about the general reaction pattern. We do not even know whether the number of lags included in our equations cover the relevant time range. Given this lack of an obvious criterion to discriminate between the different patterns estimated so far, we finally chose to use a simplified version of the last third degree polynomial approximation as starting point of our iterations. Knowing that the end-points as well as the zero-interception-points are of doubtful significance we may start our modifications at these points in the search for the best possible fit.

Our first approximation-by-iteration attempt proved to be a failure. Using the iteration criterion to accept only weight pattern modifications which would improve the fit, that is, reduce the standard error of estimate (or equivalent, increase R^2), we were not able to eliminate some of the weights which on a priori grounds seemed implausible. These attempts were made only with respect to the data concerning imports from Germany.¹⁾ While the own price behaved "properly" including none of these weights thought unrealistic, the rest-of-the-world price could not be forced into a "desirable" pattern using the above iteration criterion. At the end-points of the estimated weight patterns we found relatively large positive weights for the future values, negative ones for the past values as relicts of the imposed third degree polynomial approximation. It seems highly implausible, for instance, that a rise in the rest-of-the-world price expected to occur only three months in the future should provoke a run on the prospectively cheaper imports from Germany. But as far as the data are concerned, our choice to eliminate such a possibility as unrealistic remains perfectly arbitrary.

1) cf. table on p. 86 "Unconstrained Iteration".

Our second attempt was somehow less ambitious. Imposing the constraints that future values of the own price can have only non-negative, past ones only non-positive coefficients, while still respecting the basic form of the third degree polynomial ¹⁾, we did not expect to improve the fit very much any longer. We thought it sufficient to demonstrate that a different, theoretically more plausible coefficient pattern, that is, a different linear combination of past and future values of the given price variables, could "explain" the behavior of import shares equally well as the above reported polynomial approximations. ²⁾ As the following table shows ³⁾ we came quite close to this modest target. However, we did not manage in this first case to produce a better fit than with the corresponding coefficient pattern derived from the Almon-approximation.

Our "Constrained Iteration" result is far from being an optimum as can be seen by comparing it to the other two iteration series. But it is certainly close to a "constrained" maximum subject to the mentioned restrictions. This approximation by iteration was a tedious business since we didn't use a specific computer program but rather did the iterations in a casual ad hoc manner : modifying the most promising coefficients and reestimating the equations until the addition to the R^2 became very small. There might be the danger of being trapped in a local maximum. However, we did the whole exercise several times and obtained always basically the same coefficient pattern : we didn't manage to fool the procedure in this present case. We may notice the fact that the relative magnitudes of the estimated coefficients are roughly the same as the ones obtained by the Almon-approximation, although the location of the peaks is slightly modified. ⁴⁾

1) i.e. one hump, one trough; reciprocally for the rest-of-the-world price.

2) On methodological aspects see e.g. JOHNSTON, op.cit. pp. 293 f; LEAMER and STERN, op.cit. pp. 22 f.

3) Comparing the Almon approximation with the "Constrained Iteration".

4) For a better appreciation of the relationship between polynomial and iteration approximations, see Fig.13/14 in the Appendix.

Comparison of iteration results with the third degree Almon approximation (given above), Germany. The dependent variable is LMSD, the data cover the period 1969.1 - 1975.12.

t	Third degree Almon approx.	"Constrained Iteration"	Modified "Constr.It."	Unconstrained Iteration
+7	.282	.227	.230	.115
+2	.141	.260 T	.265 T	.320 T
+1	.040	.100	.162	.102
0	-.028	-.053	-.054	-.079
-1	-.070	-.080	-.081	-.112 T
-2	-.092	-.080	-.081	-.100
-3	-.103	-.080	-.081	-.077 T
-4	-.108	-.093	-.095	-.090
-5	-.115	-.173	-.176	-.167
-6	-.120	-.173	-.176	-.167
-7	-.140	-.294	-.298	-.205
-8	-.211	-.324 L	-.329 L	-.240 L
-9	-.292	-.187	-.189	-.115
+3	.326	.000	.035	.418
+2	.107	.000	.000 L	.186
+1	.003	.000	.000	-.163 L
0	-.012 L	.105	.105	.023 T
-1	.037	.105	.105	-.070 L
-2	.127	.105	.105	.023
-3	.222	.264	.261	.255
-4	.306	.668 T	.662 T	.765 T
-5	.350 T	.404	.401	.441
-6	.328	.000	.000	.139
-7	.214	.000	.000	.000
-8	-.017	.000	.000	-.255 L
-9	-.391	.000	.000	-.023
R ²	.5250 ¹⁾	.5221	.5259	.5658
D.W.	1.3298	1.1851	1.1960	1.2600
SE	.05629	.05646	.05623	.05381
t _{b₁}	9.38	9.26	9.32	10.23
t _{b₂}	6.99	7.00	7.08	7.83

All the test statistics given refer to the ordinary least squares estimation of the corresponding equation

$$LMS_i = A + b_1 \left(\sum_t v_t LEP_{i,t} \right) + b_2 \left(\sum_t w_t LEPROW_{i,t} \right).$$

- 1) The corrected R² is larger here than the one of the corresponding Almon approximation : instead of the four exogenous variables of the third degree Almon approximation there are only the two combined price variables besides the constant.

Whether the additional local maxima and minima appearing in the "Unconstrained Iteration" pattern have any significance is hard to say. After all, this is a simple linear combination of price variables and noise in the data may affect the final outcome. But the basic pattern is undoubtedly confirmed by this iteration exercise. We thus may look at the results in the remaining four cases.

The preliminary approximations concerning imports from France and from Italy turned out to be quite satisfactory. Relatively small modifications, needed to eliminate the "improbable" coefficients, produced a better fit in the French case while reducing the goodness of fit only marginally in the Italian case.

	Third degree Almon approx.	Constrained Iteration	Third degree Almon approx.	Constrained Iteration
	France	France	Italy	Italy
t				
+3	.294	.094	-.677	.000
+2	.155	.103	-.164	.000
+1	.053	.357 T	.113	.048 T
0	-.017	.188	.004 T	.000
-1	-.061	-.075	.156	-.012
-2	-.082	-.150	.018	-.060
-3	-.080 L	-.300 L	-.162	-.192
-4	-.087	-.225	-.237	-.421
-5	-.070	-.056	-.457	-.625 L
-6	-.072	-.047	-.477 L	-.589
-7	-.071 T	-.038	-.346	.000
-8	-.081	-.038	-.017	.000
-9	-.108	-.038	.558	.000
+3	-.324	.000	-.162	-.415
+2	-.104	-.240 L	-.104	-.554
+1	.031	-.196	-.046	-.588 L
0	.100	-.044	.008	.000
-1	.118 T	.065	.058	.260
-2	.100	.196 T	.103	.260
-3	.062	.109	.147	.260
-4	.021	.109	.174	.260
-5	-.008 L	.109	.198	.277
-6	-.008	.087	.212	.277
-7	.035	.087	.216 T	.294
-8	.139	.087	.209	.519 T
-9	.318	.087	.188	.450
R ²	.3499	.3896	.6354	.6308
D.W.	1.3984	1.3503	2.3120	2.1570
SE	.05092	.04934	.07499	.07546
F (dummies)			12.158	11.873
t _{b1}	5.23	6.14	5.61	5.45
t _{b2}	6.72	7.05	5.30	5.44

While we notice that the major peaks have been moved only slightly, their relative magnitudes are changed to quite an extent. This is due essentially to differences in the spread of the trade response over different numbers of periods as can be seen by comparing the total, i.e. long run, responses reflected by these groups of coefficients. The total effects expressed as $\sum b_t$ were the following :

In the third degree Almon approximations given above

	Germany	France	Italy	U.K.	U.S.
own price	-.846	-.277	-1.589	-.839	1.431
RoW price	1.597	.479	1.197	-.738	1.156

In the iteration approximations already given ("Constr. It.")

	Germany	France	Italy
own price	-.800	-.225	-1.851
RoW price	1.651	.456	1.300

This high degree of concordance may be taken as a further indication that our approximations by iteration are more than ad hoc "fishing expeditions", despite the admittedly crude way in which they were done.

So far we had no major problems imposing the mentioned a priori restrictions about the shape of the coefficient patterns to be estimated. No negative coefficients for the future values of the own price, as well as no positive coefficients for the past price variables together with indifference over the sign of the present price variable (reciprocally for the rest-of-the-world price), those were the restrictions imposed on the desired coefficient patterns. Since we treated these trade relationships as demand determined relationships, we had, of course, implicitly assumed that the total effect of the own price would be negative, the effect due to the rest-of-the-world price be positive. As can be seen from the above data concerning the Almon approximations, this implicit assumption appears to be contradicted by the results obtained in the U.K. and U.S. cases. In fact, the total response turns out to be the same towards the own as well as towards the rest-of-the-world price, though negative in the case of Britain, positive as regards imports from the U.S..

We shall, nevertheless, use the third degree Almon approximations given above as our initial patterns and attempt to obtain at least somewhat more plausible patterns through our iteration method.

	Third degree Almon approx.	Constrained Iteration	Third degree Almon approx.	Constrained Iteration
	U.K.	U.K.	U.S.	U.S.
t				
+3	1.048	.277	2.284	.297
+2	.225	.305 T	.408	.357
+1	-.268	.139	-.684	.369 T
0	-.493	.111	-1.138 L	.131
-1	-.514 L	-.208	-1.106	-.594 L
-2	-.393	-.264	-.735	-.416
-3	-.191	-.277 L	-.174	-.207
-4	.029	-.208	.428	.000
-5	.205	-.139	.920	.000
-6	.274 T	-.139	1.156 T	.000
-7	.175	-.139	.985	.000
-8	-.156	-.139	.259	.000
-9	-.780	-.139	-1.172	.000
+3	-1.587	-.491	-.030	.000
+2	-.689	-.765 L	-.017	-.025
+1	-.091	-.687	.069	-.146
0	.256	-.196	.200	-.219 L
-1	.403 T	-.157	.346	.015
-2	.400	.177	.479	.073
-3	.296	.275	.572	.146
-4	.141	.471 T	.596 T	.292
-5	-.013	.392	.523	.365 T
-6	-.118	.196	.324	.219
-7	-.123 L	.078	-.030	.073
-8	.021	.000	-.565	.000
-9	.366	.000	-1.311	.000
R ²	.5755	.5505	.4850	.3006
D.W.	1.7465	1.6168	1.0880	.8356
SE	.11423	.11755	.23616	.27521
F (dum.)	7.222	5.607	6.739	4.047
t _b	5.51	4.89	5.63	1.78
t _{b1}	6.10	5.97	4.50	2.68
t _{b2}				

The total effects expressed as $\sum b_t$ were the following

own price	-.839	-.820	1.431	-.064
RoW price	-.738	-.707	1.156	.793

We shall not attempt in this chapter to explain any of the empirical results and thus simply report our actual findings.

In the British case we managed to impose our restrictions without too many difficulties. However, both the total effects remained negative as in the underlying Almon-approximation. In the U.S. case we were able to derive a perfectly plausible pattern but at a considerable loss in goodness of fit. Even worse, the scale parameters, estimated by ordinary least squares, can hardly be considered to be significantly different from zero since our t-values are most likely overestimated, as is indicated by the small value of the Durbin Watson statistics.

Throughout these exercises we noticed a remarkable stability as far as the global results are concerned. Whether we used second or third degree Almon-approximations, included six or nine past periods in the combined price variables, or estimated the pattern by iteration, the different reaction patterns - with the exception of the U.S. case - remained practically unchanged. In addition, despite the relatively low Durbin Watson statistic obtained in the German and French cases, there can scarcely be any doubt that all the coefficients reported in these series, with the mentioned exception of the U.S. case, may be regarded to be significantly different from zero.

f) Testing for Longer Reaction Patterns

Have we really answered the question about the trade response pattern yet ? Up to now we have produced mostly well-behaved coefficient patterns showing troughs and humps well within the number of lags included in our equation. This number of lags included never exceeded nine, that is, we always implicitly assumed that most of the trade adjustment was completed within only three quarters. On the other side we also assumed expectations to affect trade only within a single quarter. While this latter assumption appears quite plausible ¹⁾, we do have much less reason to believe that past experience should have no effect anymore after the short period of only nine months. Clearly, some decisions affecting international trade - e.g. decisions with respect to agricultural products - have to be taken on an annual basis and there are many reasons to believe that even longer lags - up to several years - should be considered. ²⁾

While we doubt that lags of several years produce a measurable impact in the aggregate relationships we are interested in, we can not ignore the fact that some of our Almon-approximations produce "open ended" coefficient patterns possibly indicating that too few lags were included in these cases. ³⁾ Thus, it appears necessary to repeat our exercises, allowing this time, however, for longer adjustment periods. Since the simple inclusion of more lagged price

1) It is hard to see how a trader should accurately forecast exchange rate changes - so to make his reactions actually measurable - when even the foreign exchange forward market seems to reflect rather static expectations. We found, e.g., for the early period of floating of the Swiss Franc versus the U.S. dollar, March 1973 to December 1974, a correlation of .99 between the actual spot and forward rates, but only a correlation of .33 between the actual spot rate and the corresponding forward rate lagged three periods. (International Financial Statistics, lines a and b)

2) cf. e.g. JUNZ, H.B., RHOMBERG, R.R., "Price Competitiveness in Export Trade Among Industrial Countries", AER, May 1973, pp.412 ff.

3) cf. e.g. the pattern concerning the own price in the German case (third degree Almon approximation).

variables is inoperable (rounding errors becoming too important), we transformed our original data set from monthly to quarterly observations and repeated most of the above exercises allowing so to cover an adjustment period of more than two years. This transformation has the additional advantage of reducing the relative noise level in our data. This property being, however, a pure technicality due to the use of larger aggregates, we shall have to be careful comparing results from the two exercises on mere grounds of goodness of fit. But, of course, if there exists the "true" linear relationship between import shares and importables' prices, as measured above, we shall obtain identical results irrespective of the aggregates used. If, on the other hand, the true relationship involves longer adjustment periods than allowed for in the first exercise the total effect measured by $\sum_t b_t$ will turn out to be larger than the one obtained above.

In this series we calculated six different Almon-approximations for each country case : a second and a third degree polynomial approximation comprising besides the present one one future and six, respectively nine past observations of the price variable, as well as a third degree approximation allowing for two future and six, respectively eight past values of the price variable to be included.¹⁾ It became quickly clear that the inclusion of two future periods was not very realistic. In fact, this exercise produced "perverse" aggregate results in the cases of German and Italian import shares, that is, positive signs as regards the own price, negative as regards the rest-of-the-world price.²⁾ These are the only

1) The import shares are calculated from the quarterly aggregates of the trade (flow) data. The prices used are the quarterly averages of the previously used monthly data whose exchange rate components are end-of-period data; the first quarter of 1971 is set equal to 100.0.

2) Including two future, the present and eight past observations of the price variables. Both aggregate coefficients turned out negative when only six past observations were included.

For evidence of long term accurate expectation formation cf.,

exceptions to our a priori expectations as far as these two countries are concerned ¹⁾ and we can safely attribute this outcome to the unrealistic specification. While the U.K. and U.S. cases again demonstrate a rather strong sensitivity to the number of lags included and the particular form of the approximation used, we notice a remarkable stability in the results concerning imports from France. The signs are always "right" and the relative magnitudes of the aggregate coefficients practically the same as in the equations using monthly observations. ²⁾

To get a better idea of the magnitudes involved let us compare some of the long run results, Σb_t . Seasonal dummies were used, as before, only in the cases of Italy, the U.K., and the U.S.:

Second degree Almon-approximation with one future, the present, and six past observations of the price variables ($t = +1, \dots, -6$)

	Germany	France	Italy	U.K.	U.S.
own price	-.540	-.644	-1.330	-1.813	-4.006
row price	1.542	1.447	.773	-.926	-2.278

Second degree Almon-approximation ($t = +1, \dots, -9$)

own price	-.402	-1.545	-.661	-.702	-5.913
row price	2.361	2.303	.510	-1.941	-2.308

Footnote continued : ... e.g., DOMINGUEZ, J.R., Devaluation and Futures Markets, Lexington Mass., D.C. Heath and Company, 1972, particularly chapter 3 analyzing arbitrageurs' behavior in the cocoa futures markets of London and New York during the period preceding the November 1967 pound devaluation. But notice also the evidence with regard to inaccurate expectations build up during earlier pound crises in the fifties and sixties (chapter 4) when the expected exchange rate change did not occur.

- 1) One out of twelve exercises.
- 2) The absolute size of these present coefficients being considerably larger, however.

Third degree Almon-approximation including one future, the present and nine past observations of the price variables ($t = +1, \dots, -9$)

	Germany	France	Italy	U.K.	U.S.
own price	-1.218	-1.373	-9.158	-1.475	-3.125
row price	7.481	2.042	4.575	-2.865	3.403

If we compare only the last two series which cover the same data ¹⁾ - although imposing a slightly different pattern - we notice immediately the formidable lack of precision of these estimates. From such a comparison it is obvious that none of these estimates can be accepted at face value and that careful examination of all the series together only may provide somewhat satisfactory results. We notice, for instance, that most of the own price peaks can be found for lags of two to three periods, the only exception being found in the German case where the location of the peaks clearly depends on the number of lags included ²⁾: the two series including nine lags give the own-price peaks for a lag of six periods. The maximum values in the rest-of-the-world price coefficient patterns are quite evenly distributed with lags from one to five periods.

But even these summary results remain terribly vague and it is for this reason that we shall attempt once more to press some more information out of our data set, using as before our ad-hoc approximation by iteration method. We shall use the second degree Almon-approximation with one future, the present and six or nine past observations of the price variables as our initial coefficient pattern. ³⁾ The data thus cover the period 1970.III through 1975.IV, that is 22 quarterly observations.

1) The estimated a_n -coefficients are given in the Appendix, table A.5.

2) Another exception being the U.S. case where no "correct" peak appears.

3) Depending on which approximation produces the better fit, but for the iterations we shall always allow space for nine past observations.

We may note right at the beginning here that the shorter Almon approximations (including only six past observations) produced a better fit as regards the import shares of Switzerland's immediate neighbors Germany, France, and Italy. The longer patterns produce better fits in the cases of the U.K. and the U.S.. However, the signs of the long run $\sum_t b_t$ coefficients are all negative in these two cases, fact which casts considerable doubt on the reliability of these estimates.

As can be seen in the following table, our "Constrained Iteration" result is far from producing the best possible fit. Increasing the weights of the last three coefficients of the rest-of-the-world combined price variable seemed to outweigh largely the loss in goodness of fit due to the simultaneous increase in the weight of the coefficient of $LEPROW_{-6}$. But we noticed also the considerable increase in the correlation between the two combined price variables. Obviously, multicollinearity is biasing our results in the last two iteration exercises, a fact which is clearly indicated by the size of the $\sum_t b_t$ coefficients in these two cases as well. We, therefore, choose, perhaps somewhat arbitrarily, to dismiss these last two cases as spurious and to retain our "Constrained Iteration" as the best approximation of the "true" pattern.

The French and Italian cases produced little estimation problems. The estimated iteration patterns do not differ very much from the underlying Almon-approximations. We may note, however, that the weights in the iteration patterns appear to favor the more recent periods and that, over all, these patterns tend to remain short. While even a small increase in these weights at the end-points of the reaction pattern in the French case would reduce the goodness of fit, we found in the Italian case that a relatively massive increase in these weights might improve the fit. We found, however, quickly that this improvement was illusory since it was due, again as in the above German case, to the obvious presence of multicollinearity. Thus, we noted that the scale factors (estimated by ordinary least squares) increased for both the combined variables when we increased the weights at the end of the own-price pattern.

Estimation results, quarterly data, Germany.

t	Second deg. Constrained		Intermediary Results		Unconstr'd
	Almon appr.	Iteration	low corr.	high corr.	Iteration
+1	.748	1.014	.966	1.206	1.566
0	.279	.426	.444	.673	.895
-1	-.072	-.146	-.139	-.174	.157
-2	-.305	-.325	-.309	-.603	-.134
-3	-.420 L	-.365	-.348	-.627 L	-.559
-4	-.417	-.507 L	-.483 L	-.603	-.805 L
-5	-.296	-.243	-.251	-.6386	-.626 T
-6	-.057	-.243	-.232	-.314	-.783
-7	-	-.243	-.232	-.289	-.787 L
-8	-	.000	.000	-.024	-.291
-9	-	.000	.000	.000	-.112
+1	-.028	-.218	-.153	-.168	-.382
0	.275	.236	.230	.192	-.035
-1	.458	.727 T	.612 T	.962 T	.937
-2	.521 T	.600	.597	.914	1.006 T
-3	.464	.418	.429	.673	.798 L
-4	.287	.400	.413	.601	1.145 T
-5	-.009	.236	.107	.332	1.075
-6	-.426	.000	.000	.313	.763 L
-7	-	.000	.000	.289	.902 T
-8	-	.000	.000	.240	.832
-9	-	.000	.000	.216	.798
R ²	.5751	.6607	.6414	.6412	.7209
R ² *	.6156	.7146	.6756	.6754	.7475
D.W.	2.4803	2.5847	2.6222	2.4963	2.5000
SE	.04324	.03864	.03972	.03973	.03504
t _{b1}	5.51	6.48	6.23	6.02	6.56
t _{b2}	4.79	5.43	5.18	5.30	5.80
Σb ₁ ²	-.540	-.633	-.584	-1.141	-1.479
Σb ₂ ²	1.542	2.400	2.235	3.427	7.839
Corr.	-.854	-.904	-.896	-.962	-.984

R²* is the uncorrected coefficient of multiple correlation. 'Corr.' is the coefficient of simple correlation between our two combined price variables. The equations contain no seasonal dummies.

This somewhat perverse effect appeared only when the correlation between the two combined variables exceeded about -.90.¹⁾

1) The correlation between the combined variables was negative in all cases (cf. definitions of price variables above p. 79)

Estimation results, quarterly data, France and Italy.

t	Second deg. Constrained Almon appr. Iteration		Second deg. Constrained Almon appr. Iteration		Modified Constr. It.
	France	France	Italy	Italy	Italy
+1	.565	.516	.140	.187	.235
0	.065	.080	-.092	-.067	-.021
-1	-.277	-.552 L	-.252	-.336	-.539
-2	-.461	-.503	-.339	-.494 L	-.748 L
-3	-.488 L	-.245	-.355 L	-.334	-.470
-4	-.357	-.098	-.297	-.267	-.406
-5	-.068	-.074	-.168	-.187	-.363
-6	.378	.000	.034	-.067	-.214
-7	-	.000	-	-.013	-.086
-8	-	.000	-	.000	-.043
-9	-	.000	-	.000	-.021
+1	-.294	-.178	-.823	-.998	-1.433
0	.141	.180	-.400	-.364	-.179
-1	.426	.535	-.058	.036	.072
-2	.562 T	.716 T	.205	.170	.287
-3	.548	.280	.388	.471	.695
-4	.385	.127	.491	.546	.806 T
-5	.071	.000	.514 T	.594 T	.806
-6	-.392	.000	.457	.388	.430
-7	-	.000	-	.024	.036
-8	-	.000	-	.000	.000
-9	-	.000	-	.000	.000
R ²	.6852	.7477	.7299	.7600	.7901
R ² *	.7152	.7717	.7942	.8171	.8401
D.W.	2.2985	2.2722	2.9834	2.9906	3.0051
SE	.02744	.02457	.05031	.04742	.04434
F (dummies)			13.359	15.280	17.341
t _b	6.73	7.72	3.38	3.90	4.64
t _{b1}	6.75	7.89	4.18	4.68	5.19
t _{b2}					
Σb ₁	-.644	-.877	-1.330	-1.578	-2.677
Σb ₂	1.447	1.659	.773	.867	1.519
Corr.	-.905	-.901	-.887	-.898	-.950

When the correlation exceeded $-.95$, this magnifying effect was unmistakable. The results are, of course, very large long run effects (Σb_t) as shown already above in the German case. To eliminate this problem we introduced, again somewhat arbitrarily, the additional iteration criterion that pattern modifications which would increase the simple correlation between the two combined variables above $.90$ should be avoided.

Although the correlation between the two combined variables exceeded in the British case $-.90$ already in the basic equation derived from the quadratic Almon approximation, we encountered no further problem for our iteration procedure. While it was impossible to force the rest-of-the-world pattern to show a positive aggregate value, its form corresponded roughly to our expectations.

Estimation results, quarterly data, U.K. and U.S.

	Second deg. Almon appr.	Constrained Iteration	Third deg. Almon appr.	Constrained Iteration
	U.K.	U.K.	U.S.	U.S.
t				
+1	.366	.149	1.433	.775
0	-.060	-.309	-1.000	-.433
-1	-.377	-.329	-1.415 L	-.487 L
-2	-.583	-.379	-.667	-.216
-3	-.680 L	-.518	.391	-.043
-4	-.667	-.665 L	.906 T	-.016
-5	-.543	-.329	.024	-.011
-6	-.310	-.100	-3.109	-.005
-7	.033	.000	-	.000
-8	.487	.000	-	.000
-9	1.050	.000	-	.000
+1	-1.861	-1.162	-1.329	-.135
0	-1.038	-1.162	.357	.077 T
-1	-.377	.219	.912 T	.077
-2	.122	.232	.691	.058
-3	.459	.369 T	.044	.039
-4	.634	.369 T	-.676	.002
-5	.647 T	.000	-1.118 L	.000
-6	.497	.000	-.929	.000
-7	.186	.000	-	.000
-8	-.288	.000	-	.000
-9	-.924	.000	-	.000
R ² *	.6174	.6211	.6621	.3043
R ²	.7085	.7113	.7426	.4700
D.W.	2.7924	2.6626	2.7175	1.3591
SE	.07978	.07940	.17017	.24417
F (Dum)	6.309	7.114	9.123	4.630
t _{b1}	4.11	4.14	4.40	1.14
t _{b2}	4.32	4.00	3.42	.21
Σb ₁	-.702	-2.478	-3.439	-.436
Σb ₂	-1.941	-1.135	-2.046	.118
Corr.	-.903	-.725	-.686	-.032

All equations contain seasonal dummies.

The U.S. case was quite different. Starting from the two quadratic Almon-approximations as well as using the longer third degree Almon pattern as initial coefficient configuration, we could not attain anything which would correspond to our expectations. Only the shorter third degree Almon-approximation allowed us to derive a "plausible" pattern, but at the cost of a considerable loss in goodness of fit.

g) Summary of the Empirical Analysis

These 'last results bring us to the end of our computations. We have pressed the data hard enough and can scarcely hope to get any more information out of this data set, at least not as long as we refuse to employ any more complex investigation technique. It may, therefore, be desirable to sum up what we have done so far before we turn in the next chapter to the problems of interpreting our findings.

At the beginning of our empirical investigation into the fundamental quantity-price relationship - expressed by the equation $MS_i = f(P_i, P_A, \dots)$ - we found that theoretical as well as empirical reasons suggested that the effects of price variations on import shares could best be described by a distributed lag relationship. When we found that multicollinearity prevented us from estimating a relation like $MS_i = A + a_0^p i_0 + a_1^p i_{-1} + \dots + a_t^p i_{-t}$ in a straight forward manner, we had to search for approximation methods which would allow us to circumvent this problem.

The most obvious way to eliminate multicollinearity due to the high correlation between the differently lagged price variables is the removal of these price variables as independent explanatory variables. There are basically two ways to achieve this goal : the first one is to specify some long-run relationship together with some short-run adjustment mechanism. The best known representative of this class is certainly the Koyck distributed lag analysis referred to, but much more complicated systems using higher time derivatives to specify a more complex adjustment mechanism could be devised.

The second method, the one which we preferred for our own computations, does not have this analytical content of describing the underlying mechanisms of a distributed lag relationship. The Almon lag approximations as well as our own iteration approximation do not have any analytical but only descriptive pretense, leaving the analytical part of the investigation entirely to the interpretation of the results. While the Almon-lag procedure is quite liberal imposing only a basic form of coefficient configuration leaving the

data to determine the signs and the size of the estimated parameters ¹⁾, we chose in our iteration approximations essentially to restrict only the signs of the coefficients to be estimated. We could do this with so much more confidence as we could build on the results of the preceding Almon-approximations which had confirmed our most naive expectations. Since our trade data series contain quite a bit of noise, we introduced, however, one further restriction to eliminate completely spurious effects : thus, we tolerated only one hump and one trough for each of our combined variables.

We should, perhaps, in this context discuss the particularity of our inclusion of future prices in our combined price variables. As has been shown above, the Almon transformation is a completely general data transformation and does, therefore, allow the easy incorporation of future prices into the time horizon of the investigation method. This may not be true for analytical methods which take the expectation formation explicitly into account. Since we had argued at the outset of this chapter that lead and lag effects were among the important short run determinants of trade, our descriptive technique clearly had to allow for this possibility. But we should notice here that our technique is able only to reflect accurate expectations since the future prices we are using are the actual future prices rather than some proxy for expected prices.

What have we found ? After eliminating a number of problems connected to the use of relative prices ²⁾ we settled finally on an equation of the form $LMS_i = A + a_1LEP_{i,+3} + \dots + a_{13}LEP_{i,-9} + b_1LEPROW_{i,+3} + \dots + b_{13}LEPROW_{i,-9} + \text{dummies}$, where EP_i is the "own" price and $EPROW_i$ the corresponding rest-of-the-world price. Our reasons for choosing the logarithmic form were, unfortunately, not theoretically founded but simply reflected criteria of practical convenience. The estimated coefficients having become dimensionless parameters we could attempt to add them up to construct what we cal-

-
- 1) The form imposed being some simple polynomial.
 - 2) Interdependence of the price variables and even complete singularity of the price matrix; biases of estimation results possibly due to the imposition of unwarranted homogeneity conditions, ...

led the long run price effect $\sum b_t$. It should be clear that this is not really a proper procedure but only represents an approximation to some long run effect since, e.g., $EP_{i,+3}$ and $EP_{i,-9}$, in the short observation period which we cover, do not represent identical price series.

We estimated the coefficients of the above type equations using various Almon-lag approximations. While the results concerning future prices remained somewhat ambiguous, we obtained the expected negative coefficients for past values of the own price and positive coefficients for the competing rest-of-the-world price. We also noted that the expected peaks could be found in most cases well within the number of lags allowed for, suggesting that the number of lags included in our equations not unrealistically covered the main reaction period. This conclusion might have been a bit hasty, however, since the Almon-approximation, imposing a strict form of a given polynomial, might produce peaks where there shouldn't be any. Also, some of the end values of the estimated patterns appeared hardly plausible but could be explained by the imposition of too rigid a coefficient configuration.

Our iteration procedure was thus thought to allow to eliminate this unnecessary rigidity permitting completely non-linear reaction patterns. We thus rewrote our equation as

$$\begin{aligned} LMS_i = & A + b_1(v_1LEP_{i,+3} + v_2LEP_{i,+2} + \dots + v_{13}LEP_{i,-9}) + \\ & + b_2(w_1LEPROW_{i,+3} + w_2LEPROW_{i,+2} + \dots + w_3LEPROW_{i,-9}) \\ & + \text{dummies.} \end{aligned}$$

Assuming that there exists only one combination of weight patterns v_t and w_t which minimizes the standard error of estimate (or equivalent : maximizes R^2), we set out to find this combination by modifying each individual weight and checking whether the particular modification could improve the goodness of fit. These iterations might not have been overly systematic ¹⁾ but we managed in most cases to eliminate the completely implausible coefficients derived

1) However, for each iteration we tested in the average several thousand individual coefficient modifications !

from the Almon-approximation, and, by removing the rigidities of the polynomial approximations to produce coefficient patterns of comparable or even better statistical quality.

Our basic findings from the analysis with monthly data were confirmed by the use of quarterly aggregates. It might be noteworthy that lags of more than one and a half year were retained only in the iterations concerning imports from Germany and Italy, while in all other cases measurable adjustment seemed to be completed within this period. But the interpretation of the results will be left to our concluding chapter.

IV. Conclusion

a) The Questions Which Can Be Answered. Some Warnings.

In the preceding chapter we went through quite a number of econometric exercises. As outlined in the earlier chapters, we hoped that these exercises could make us understand better some of the fundamental relationships in international trade. Analyzing the Swiss importers' reactions towards changes in the relative prices of tradables - in particular to changes in prices provoked by changes in the exchange rates - we hoped to be able to produce answers to a whole series of questions : Do prices matter in international trade ? If yes, does trade respond quickly to these changes ? Are the quantitative reactions sufficiently strong to outweigh the changes in prices, that is, can we expect expenditure to decline when prices rise and vice versa ?

While these are the most important questions as far as this paper is concerned - and to which we are now able to give some reasonably specific answers - other questions have been touched on in the introduction to which this paper, unfortunately, may only provide some elements of an answer. Questions such as the desirability of a system of flexible exchange rates clearly cannot be answered by such a limited study. Nevertheless, we think that the insights provided by this paper may give some additional elements to the discussions of the links between monetary and real phenomena and consequently to the policy measures which can be used to stabilize the real economic world we live in. Answers with regard to links between speculators' and traders' behavior, another question hinted at in the introduction, cannot be given here either. But we may have gained in this exercise at least a better idea of the trade reaction lags, certainly one of the essential ingredients for the analysis of such links.

Discussing our empirical findings, some warnings must constantly be kept in mind : While the strong exchange rate fluctuations of the past few years have provided us an almost unique opportunity to analyze the price-quantity relationship in interna-

tional trade, we must not forget that this period was essentially a transitional period. We saw the collapse of a system in which the most important international prices, that is the exchange rates, were completely stable. Even when in the late sixties some exchange rates were changed, the basic system had not been altered. These changes were expected to be once-and-for-all variations and the new rates were expected to last for a very long time. As true as it was that the just devalued currency was the safest currency to be held, so true was it that specific commodity prices - fixed in terms of any of these stable currencies - could be expected to change only in response to changing business conditions in the particular commodity market concerned.

Such expectations will not prove right any longer. The generalization of the flexible exchange rate system in early 1973 had clearly shown that a new element of instability in the prices of tradables had to be reckoned with. While the first large exchange rate changes might still have been understood as a once-and-for-all currency realignment, the subsequent experience with considerably varying exchange rates must have brought home the message of fundamental double price instability to each and every one active in international trade. That traders' reactions might be affected by such considerable changes in the monetary environment can certainly not be ruled out. We are, however, not in a position to test for this kind of changes in the traders' behavior. All data series concerning these last few years contain very much noise and a longer period will be required to make statistical inference possible and meaningful.

It must be emphasized here - and such a warning ought to precede any discussion of similar econometric results - that our investigation technique implies that the analyzed trade behavior has not changed during the period of investigation. The fundamental character of the relationships analyzed and the relatively short period dealt with as well as the relatively good statistical quality of the empirical results are all arguments in favor of accepting this implicit assumption as a useful working hypothesis.

b) Trade Reactions to Price and Exchange Rate Changes

The first question we shall try to answer is the most fundamental one : Do prices matter in international trade ? While the affirmative answer to this question - reflecting the received wisdom contained in any textbook concerned with international trade - may appear self evident, we may recall the findings on Swiss foreign trade relations given earlier : Prices were reported to have, if at all, only a very limited effect on trade.¹⁾

We think that the results presented in the previous chapter confirm beyond any doubt that prices do matter. We noticed a solid consistency as regards the general reaction patterns estimated : A negative long run response to variations in the own price, a positive long run response to changes in the rest of the world price. Exceptions were rare and due either to obvious misspecification or, in the U.S. case, to the presence of a very high relative noise level in the data. While the Almon lag estimations, allowing the data to choose the shape of the distributed lag response pattern, did not always produce the ideal coefficient pattern expected, they produced in more than eighty percent of all cases patterns which conformed to our general a priori expectations.²⁾ The iteration approximations which we proposed showed that perfectly plausible coefficient patterns, that is, linear combinations of the lagged prices corresponding to our a priori expectations, were able to produce as good and even better results than the earlier Almon approximations.

It is certainly noteworthy that despite the crude approximations used in these exercises, we were able to explain, in the average, about 50 % of the total variance of the import share data by the mere use of proxies for the prices of tradables ! ³⁾

1) cf. above : SCHERER, quoted on p. 34; HERRIGER, quoted on p. 37; SOHRMANN, quoted on p. 50, footnote 1).

2) Aggregate results had the expected sign in 45 out of 55 reported cases. All exceptions are for the U.K. and U.S. data.

3) Monthly data; almost 70 % with quarterly data. Seasonal dummies are included in the cases of Italy, the U.K., and the U.S.

The weights used for the computation of the rest-of-the-world prices were clearly arbitrary and might have overemphasized somewhat the German price level. Together with the interdependence of the different import share variables ($\sum w_i = 1.0$), one might argue, we constructed a somewhat symmetrical world ensuring pleasant results in all cases when only the German case would turn out "correctly". While this interdependence effect might have played some role in the determination of our results, we feel that the quite consistently "correct" response patterns with respect to changes in the own price clearly discount the importance of such possible symmetry effects. We, therefore, consider this first question settled, at least as far as the particular trade structure during the period analyzed is concerned.

We thus may turn to our second fundamental question : How fast do traders respond ? We had noted earlier that the measured reaction patterns were not uniform with respect to price variations in the different countries. This is true not only with regard to the location and amplitude of peaks but also with regard to the spread of the response through time. Thus, we notice that the long run coefficients regarding imports from Germany are about three times as large as the corresponding coefficients for the French case if we consider only the computations using monthly data, allowing for not more than nine months response period. The computations using quarterly data, allowing lags up to nine quarters, show clearly, however, that the long run response is of equal magnitude in both cases. The long run coefficients in the other three cases are, unfortunately, too volatile to allow such a broad comparison. Thus, the response in the Italian case appears to be smaller when longer lags are allowed for, result which can hardly be accepted at face value.

In all our exercises we included at most nine past quarterly observations of the price variables, thus excluding the possibility of measuring trade reactions lagged more than two and a half years. This limitation, which was imposed on technical grounds, did not seem to distort our results, however. In fact, none of our iteration exercises suggested measurable response lags longer than seven

quarters, that is, we didn't find any reaction pattern with lags exceeding two years.¹⁾

Moreover, we found that the extension from the earlier analysis including only nine monthly lags to the one including nine quarterly lags increased the long run coefficients only in the cases of France, the U.K., and the U.S.. As already stated, the long run effects appear smaller in the Italian case, while they remain roughly the same in the German case. This may be taken to suggest that nine months are sufficient in these two cases to cover most of the adjustment period while longer lags are required in the other three cases. There remains some ambiguity in this result, however, since it is exactly the German and Italian response patterns only where we retained non-zero coefficients for lags of seven quarters in our final "Constrained Iteration" results. But, generally speaking, we can assert without hesitations that the response patterns investigated turned out to be quite short and that the thrust of the trade response to price variations was completed within four quarters. The average lag for the reaction peaks is about two and a half quarters.

The present results may perhaps be seen in the proper perspective when we compare them with results obtained by Magee on what he called the traders' currency-contract period.²⁾ Analyzing

1) But cf. JUNZ, H.B., RHOMBERG, R.R., op.cit., p. 418. They found the trade response to variations in relative prices to attain a maximum for lags between three and four years. They are using annual data; market shares are given in value terms; prices used are unit value indices. The saw-tooth character of their estimated response patterns seems, however, suspect of reflecting collinearity problems. The only equation comparable to our present exercises, that is, equation B in table 1, p. 416, shows the price coefficients for lags of four and five years not to be significantly different from zero; the corrected R^2 of .022 is rather small.

2) MAGEE, S.P., op.cit., pp. 135-145, tables 5-7.

the time lag between an exchange rate change and its actual relevance for trade, that is the period between any exchange rate variation and the renewal of ongoing trade contracts, he found that for U.S. imports from Germany and Japan this relevant contract period was quite short. Between eighty and ninety percent of trade contracts would come up for renewal (would be fulfilled) in a six months period, while more than 95 percent of all trade contracts would be fulfilled within one year. In the reported sample this currency-contract effect had faded completely after 22 months, that is less than two years.

In the context of our present study it seems plausible to relate Swiss importers' responses to changes in the relative prices of foreign competitors to the contract period, particularly since we can treat Switzerland as a small country facing quite elastic foreign supply curves. It may be plausible, in a period of flexible exchange rates, that fundamental structural changes do not occur as consequences of exchange rate variations which have to be considered to be reversible, and that most trade reactions measured in our exercises concern short term trade contracts of the type discussed by Magee. We do not have comparable information, however, as regards Switzerland's imports and may, therefore, better leave these questions for someone else to investigate.

We thus come to our third important question, that is : How much does trade respond to price and exchange rate variations ? This is certainly the most difficult of these three questions and we shall hardly be able to provide as clearcut answers as to the earlier ones. Comparing the long run effects (Σb_t) as contained in our "Constrained Iteration" results we obtain an average response to changes in the own price of -1.20 and to changes in the rest-of-the-world price of 0.78 . The results regarding only the German, French, and Italian, that is, the statistically more reliable cases are -1.03 and 1.64 respectively. This is roughly equivalent to say that the elasticity of import shares with respect to changes in the specific own as well as to changes in the rest-of-the-world price is slightly higher than unity in the long run.

We noticed, however, in our earlier comparison of prices and exchange rates that our proxy for tradables' prices, LEP_i , reflected variations in the actually traded goods' prices, $LUPM_i$, only partially and that, thus, our eventual elasticity estimates would tend to be overestimated.¹⁾

So far we have considered only the overall, long term effect of an exchange rate or price variation and have found that quantity responses appear to be slightly larger than the price variations which are causing them, thus affecting expenditure in a way compatible with the stability requirements of the earlier elasticity approach.

This is not the whole answer, however. Our analysis has departed from the traditional way of investigation through the inclusion of future prices into our time horizon. This opened some interesting new perspectives: While our actually measured results concer-

1) cf. chapter I, p. 30. We noted that $LUP = a LEP$, $a > 1$. If the true trade relation is $LMS = \eta LUP$ then we shall have the estimation results $LMS = \eta a LEP$ where ηa , our estimated trade elasticity, exceeds the "true" η . Since in $LUP = b LE + c LP$ (p. 28) b is approximately unity, η reflects quite well the effect of exchange rate variations. Thus, our estimated trade elasticity, ηa , overestimates the influence of exchange rate variations. Notice, however, that c and a are roughly equivalent and that this bias, therefore, does not distort the measurement of the effects due to changes in prices. We should notice also that these elasticities are not identical to import elasticities. Since the quantities imported from any specific country are deflated by the overall imports, the resulting import share elasticities may be smaller than the true import elasticities, depending on the price effect on overall imports (the bias being proportional to the size of the import share as well as to the absolute magnitude of the elasticity). This possible bias is, however, small and does not alter our general findings. Notice that reasoning in terms of absolute figures rather than in order of magnitudes makes little sense anyhow since the statistical precision is much more apparent than real.

ning the future prices may appear sometimes a bit excessive they, nevertheless, can be taken to reflect a real phenomenon. Leads and lags are clearly documented in all estimated iteration patterns.¹⁾ Since the lead effects, by their very nature, have the opposite sign as compared to the traditionally analyzed lagged responses to price changes, their exclusion from the analysis necessarily produces strong overestimations of the long run trade reactions, $\sum b_t$. Thus, if we disregard the coefficients for the future observations of the price variables we obtain an average response to changes in the own price of -1.73 and to changes in the rest-of-the-world price of 1.32, that is, considerably more than the -1.20 and 0.78 reported above as "true" long run responses.

Taking this lead effect into account we may notice that the long run effect, $\sum b_t$, of a price or exchange rate change will thus have a seemingly perverse effect²⁾ and that several months may have to pass just to restore the situation which would have existed without this price variation. In our final "Constrained Iteration" results this zero-effect point is given for an average lag of about 1.7 quarters considering only the German, French, and Italian cases. The corresponding figure computed from the iterations using monthly data indicates an average lag of the "zero-effect point" of roughly four months. Of course, it would be pure fantasy to split the reaction period into a first half used to restore the previously held position and a second half for "true" adaptation to the changed price structure. But it is certainly worthwhile to insist on the fact that more than a quarter is required just to cancel out the effect produced by the anticipation of the price variation. One might meditate with Einzig on the

1) cf. also appendix table A.6, p. 127. For the theoretical aspects of leading and lagging in a system of flexible exchange rates cf. EINZIG, P., Leads and Lags, London, St. Martin's Press, 1968, chapter 12 : "Floating Exchange Rates", particularly pp. 93/4 and 97/9.

2) Adding to the nominal effect known as J-curve effect.

implications this behavior will have on the foreign exchange markets.¹⁾

1) *ibid.*

c) An Excursion into Speculative Economics

We have answered now the three basic questions "whether", "how fast", and "how much" price changes (and thus exchange rate changes) have affected Swiss importers' behavior during the recent period of ever more fluctuating exchange rates. We have provided elements for reflection with respect to possible connections between trade reactions and foreign exchange speculation. We have produced a large number of quantitative informations which may be helpful for understanding better some of the disaggregated relationships. We may thus be allowed to venture at this stage a bit more into the fields of economic speculation trying to extract some macroeconomic conclusions from our basically microeconomic exercises.

We have, in the previous chapter, analyzed only import relationships. While this, per se, proved not uninteresting, it did not quite respond to our initial preoccupation with the possible effects the continued revaluation of the Swiss franc might have on domestic economic activity in Switzerland. While we noted that Swiss importers showed quite swift reactions to any price variations in the different foreign supplier countries, at least in terms of quantities - in the longer run even in terms of values - we were not able to produce any quantitative indications as regards Swiss export performance.

We had argued earlier that, despite the fact that Switzerland as an importer could reasonably be considered a small country facing elastic foreign supply for most of the imported products, we could not consider this small country assumption to be adequate as far as Switzerland's position as an exporter is concerned. We thus argued that Swiss exports would have to be considered determined rather by the demand of the foreign importers than by domestic (supply) factors. Even if we treat thus Switzerland as a large country facing less than perfectly elastic world demand for its exports, it is obvious that Switzerland is far from enjoying a monopoly position. It is, therefore, plausible that foreign traders will react to Swiss exchange rate variations in exactly the same way as Swiss importers respond to foreign price variations.

While it is plausible that the high degree of specialization in the Swiss export sector as well as the traditionally high quality of the products and the reliability of agreed delivery delays may take some of the edge out of the short term fluctuations produced by leading and lagging and may tend to spread the real adjustment over a longer period than the one observed in our import analysis, it is highly unlikely that the continued fluctuations in the exchange rates will not affect these exports.

Our initial preoccupation with relationships between internal and external equilibrium has taught us to distinguish between nominal and real variations. While, for the purpose of balance of payments analysis, we are interested essentially in the values traded and may thus attach some (even limited) importance to specific elasticity estimates, the things which matter in terms of employment are the quantities actually traded. The fact, noticed earlier, that the long run elasticities of import shares with respect to exchange rate variations were in the neighborhood of unity would suggest that the effect of such exchange rate variations on the trade balances was rather limited. The quantity variations, on the other hand, have undoubtedly been considerable throughout these up and down fluctuations of the exchange rates. Such trade variations may be at the origin of considerable domestic transfers. But we can hardly think that these ever reversible fluctuations serve a useful purpose for the nation as a whole.

Appendix

Table A.1 : Almon-lag estimation using all five relative prices as explanatory variables.

Table A.2 : Bivariate relationships. Third degree polynomial approximation.

Table A.3 : Third degree polynomial approximation of the equation $LMS_i = f(LEP_i, LEPROW_i)$.

Table A.4 : Second degree polynomial approximation of the equation $LMS_i = f(LEP_{i,future}, LEP_{i,past}; LEPROW_{i,f.}, LEPROW_{i,p.})$.

Table A.5 : Estimated coefficients for polynomial approximations using quarterly data.

Table A.6 : An alternative test for the significance of future prices as explanatory variables.

Fig.13 : Graphical comparison of polynomial and iteration approximations (monthly data).

Fig.14 : Graphical comparison of polynomial and iteration approximations (quarterly data).

Table A.1 : Almon lag estimations using all five relative prices
as explanatory variables.

The estimated equations have the form

$LMSD_{-3} = \sum_i \sum_n \sum_t a_{i,n} t^n LRP_{i,t}$ where $t = 0, \dots, 13$ indicates the number of lags of the price variable, $n = 0, \dots, 3$ corresponds to the degree of the Almon approximation, and $i = D, F, I, UK, US$ stands for the five countries considered : Germany, France, Italy, U.K., U.S.. The data cover the period: $LMSD_{-3}$ 1968.9 - 1975.9, $LRP_{i,0}$ 1969.1 - 1975.12, $LRP_{i,12}$ 1968.1 - 1974.12; that is, 84 monthly observations.

The following table contains the estimated $a_{i,n}$ -coefficients in the German case; t-values are given in brackets.

	LRPD	LRPF	LRPI	LRPUK	LRPUS
a_0	7.66377 (1.47)	3.58534 (1.41)	2.50646 (1.43)	1.81894 (1.57)	1.41288 (1.30)
a_1	-5.27807 (1.50)	-2.47311 (1.50)	-2.31579 (1.74)	-1.38183 (1.76)	-.66406 (1.03)
a_2	.88500 (1.30)	.41671 (1.32)	.43228 (1.69)	.23036 (1.48)	.10236 (.82)
a_3	-.04181 (1.12)	-.01978 (1.15)	-.02186 (1.58)	-.01084 (1.26)	-.00475 (.69)
the constant is	-1.14634 (28.74)	, the corr. R^2 .5793 , D.W.			1.7903.

The following are the reaction patterns derived from the above estimated $a_{i,n}$ -coefficients; $t' = t + 3$ indicates leads and lags.

$t' = t + 3$

+3	7.664	5.585	2.506	1.819	1.413
+2	3.229	1.509	.601	.657	.846
+1	.313	.148	-.571	-.110	.458
0	-1.334	-.618	-1.141	-.546	.214
-1	-1.964	-.906	-1.239	-.716	.090
-2	-1.828	-.835	-.998	-.686	.058
-3	-1.176	-.524	-.548	-.521	.087
-4	-.259	-.092	-.020	-.284	.151
-5	.672	.343	.454	-.043	.219
-6	1.367	.661	.743	.139	.265
-7	1.573	.745	.717	.197	.258
-8	1.041	.476	.243	.064	.172
-9	-.481	-.266	-.809	-.323	-.024

The following tables contain the corresponding results in the French case

	LRPD	LRPF	LRPI	LRPUK	LRPUS
a_0	-1.61435 (.34)	-.31396 (.13)	-.12921 (.08)	-.64430 (.60)	-.53331 (.53)
a_1	2.11059 (.65)	.70645 (.47)	.70935 (.58)	.80562 (1.11)	.37435 (.63)
a_2	-.52624 (.84)	-.20097 (.69)	-.18875 (.80)	-.17481 (1.22)	-.09153 (.79)
a_3	.03178 (.92)	.01267 (.80)	.01139 (.89)	.00968 (1.22)	.00577 (.91)
the constant is	-.89386 (24.32)	, the corr. R^2 .4021 , D.W.			1.8436.

The derived reaction patterns are :

$$t' = t + 3$$

+3	-1.614	-.314	-.129	-.664	-.533
+2	.002	.204	.403	-.004	-.245
+1	.756	.396	.626	.345	-.105
0	.839	.339	.608	.461	-.078
-1	.442	.107	.417	.401	-.131
-2	-.245	-.222	.123	.224	-.229
-3	-1.031	-.573	-.208	-.013	-.336
-4	-1.725	-.871	-.506	-.250	-.419
-5	-2.138	-1.037	-.703	-.431	-.442
-6	-2.077	-.998	-.731	-.497	-.372
-7	-1.352	-.676	-.521	-.389	-.173
-8	.226	.003	-.005	-.050	.189
-9	2.850	1.118	.885	.578	.749

The collinearity problem may be illustrated by the coefficients of simple correlation of our combined variables $a_n \sum t^{nLRP}_{i,t}$ abbreviated here, for convenience, as $A_{n,i}$

	$A_{0,D}$	$A_{1,D}$	$A_{2,D}$		$A_{0,F}$	$A_{1,F}$	$A_{2,F}$
$A_{1,D}$	.988			$A_{1,F}$	.967		
$A_{2,D}$	.974	.997		$A_{2,F}$	.933	.993	
$A_{3,D}$	.964	.992	.999	$A_{3,F}$	.906	.981	.997

etc.

Table A.2 : Bivariate relationships. Third degree polynomial approximation.

The estimated equations have the form

$LMSD_{-3} = \sum_n \sum_t a_n t^n LRPD_t$ where $t = 0, \dots, 13$ indicates the number of lags of the price variable, etc. The data are the same as in Table A.1. The following table contains the a_n -coefficients estimated for the combined price variables.

	Germany	France	Italy	U.K.	U.S.
a_0	-.08779 (.31)	.49627 (2.60)	-1.02260 (2.71)	1.32254 (2.56)	1.59273 (2.77)
a_1	.13905 (.51)	-.30848 (1.71)	1.00988 (2.75)	-1.06690 (2.00)	-1.87968 (3.38)
a_2	-.04455 (.80)	.04611 (1.25)	-.21868 (2.88)	.19338 (1.73)	.41004 (3.57)
a_3	.00301 (.98)	-.00209 (1.03)	.01250 (2.98)	-.00969 (1.57)	-.02320 (3.65)

All equations include a constant; the equations concerning Italy, the U.K., and the U.S. contain also seasonal dummies. The following are the derived reaction patterns for these five cases. The test statistics given at the bottom (as in the text) refer to the above given equations.

$$t' = t + 3$$

+3	-.088	.496	-1.023	1.323	1.593
+2	.010	.232	-.219	.439	.100
+1	.036	.047	.222	-.115	-.712
0	.010	-.071	.376	-.399	-.982
-1	-.052	-.134	.318	-.471	-.850
-2	-.130	-.155	.122	-.389	-.455
-3	-.207	-.146	-.136	-.210	.065
-4	-.265	-.121	-.381	.006	.569
-5	-.285	-.091	-.539	.202	.919
-6	-.251	-.069	-.534	.320	.976
-7	-.142	-.068	-.292	.302	.600
-8	.058	-.099	.263	.088	-.348
-9	.367	-.177	1.206	-.378	-2.007
R^2 (corr.)	.3068	.2458	.5583	.4035	.3545
D.W.	.9230	1.2464	2.0029	1.2955	.8918
F (dummies)			9.232	4.599	4.172

Table A.3 : Third degree polynomial approximation of the equation
 $LMS_i = f(LEP_i, LEPROW_i)$.

The following are the estimated a_n -coefficients underlying the reaction patterns given on p. 81. The data cover the same period as in Table A.1. The price variables are the ones defined on p. 79. Dependent variable is, again, $LMS_{i,-3}$.

	Germany	France	Italy	U.K.	U.S.
Own price					
a_0	.28170 (1.30)	.29354 (1.86)	-.67703 (1.96)	1.04772 (2.40)	2.28447 (3.53)
a_1	-.16253 (.80)	-.15934 (1.07)	.64553 (1.90)	-1.00780 (2.27)	-2.28447 (3.64)
a_2	.02324 (.57)	.02129 (.70)	-.14134 (2.04)	.19585 (2.13)	.46722 (3.69)
a_3	-.00431 (.50)	.00265 (.54)	-.00018 (2.10)	.00834 (2.03)	-.00472 (3.65)
Rest-of-the-world price					
a_0	.32612 (1.77)	-.32374 (1.35)	-.16245 (.31)	-1.58746 (2.70)	-.03047 (.03)
a_1	-.28528 (1.61)	.26599 (1.15)	.05947 (.12)	1.06542 (1.88)	-.03211 (.03)
a_2	.07051 (1.94)	-.04951 (1.05)	-.00036 (.00)	-.17530 (1.52)	.05042 (.23)
a_3	-.00431 (2.71)	.00265 (1.01)	-.00018 (.04)	.00834 (1.32)	-.00472 (.40)

The following tables contain the corresponding coefficients for an approximation using only six lagged observations of the price variables

Own price					
a_0	.55560 (2.00)	.08617 (.42)	-.49925 (1.07)	1.69593 (3.23)	2.72927 (3.71)
a_1	-.50561 (1.36)	.24548 (.89)	.35806 (.55)	-2.14507 (2.91)	-3.22397 (3.17)
a_2	.11312 (1.11)	-.10157 (1.33)	-.07588 (.42)	.54554 (2.66)	.76795 (2.73)
a_3	-.00786 (1.06)	.00834 (1.49)	.00417 (.32)	-.03784 (2.50)	-.04892 (2.36)

	Germany	France	Italy	U.K.	U.S.
Rest-of-the-world price					
a_0	.44298 (1.84)	-.15997 (.52)	-.63789 (.94)	-2.22543 (2.83)	1.19910 (.85)
a_1	-.47603 (1.46)	-.01058 (.03)	.66828 (.73)	2.13227 (1.96)	-1.61051 (.86)
a_2	.13837 (1.54)	.02360 (.20)	-.14733 (.59)	-.50013 (1.67)	.48092 (.93)
a_3	-.01017 (1.54)	-.00210 (.25)	.00978 (.53)	.03362 (1.53)	-.03714 (.98)

The derived reaction patterns are the following.

$$t' = t + 3$$

Own price

+3	.556	.086	-.499	1.696	2.729
+2	.155	.238	-.213	.059	.224
+1	-.066	.238	-.053	-.715	-1.038
0	-.155	.134	.005	-.851	-1.352
-1	-.160	-.023	-.014	-.577	-1.010
-2	-.127	-.183	-.085	-.121	-.307
-3	-.103	-.296	-.182	.292	.465
-4	-.137	-.312	-.281	.433	1.011
-5	-.274	-.180	-.356	.076	1.039
-6	-.562	.148	-.383	-1.006	.255

Rest-of-the-world price

+3	.443	-.160	-.638	-2.225	1.199
+2	.095	-.149	-.107	-.560	.032
+1	-.037	-.104	.188	.308	-.395
0	-.014	-.036	.305	.578	-.307
-1	.102	.041	.304	.453	.075
-2	.251	.115	.243	.135	.527
-3	.371	.173	.180	-.175	.827
-4	.403	.202	.175	-.274	.752
-5	.283	.191	.287	.038	.078
-6	-.047	.126	.573	.963	-1.418

R^2 (corr.)	.4554	.2999	.5572	.5514	.4566
D.W.	1.2623	1.3539	2.0654	1.7293	1.0892
F (dummies)			7.859	5.859	4.838

These test statistics given refer to the above estimated equations.

Table A.4 : Second degree polynomial approximation of the equation

$$LMS_i = f(LEP_{i,future}, LEP_{i,past}, LEPROW_{i,fut.}, LEPROW_{i,p.}).$$

The following are the estimated a_n -coefficients underlying the reaction patterns given on p. 83. The data are the same as in Table A.3., the equations are described on p. 83.

	Germany	France	Italy	U.K.	U.S.
$LEP_{i,future}$					
a_0	.03412 (.08)	.08329 (.25)	-.21069 (.38)	1.79360 (2.34)	3.28028 (1.84)
a_1	.58323 (.60)	-.16281 (.19)	-.56048 (.45)	-2.27271 (1.22)	-4.92744 (1.52)
a_2	-.23618 (.73)	.11780 (.40)	.24634 (.59)	.45575 (.73)	1.27669 (1.23)
$LEP_{i,past}$					
a_0	-.07578 (.25)	-.48016 (2.05)	.55254 (1.14)	-.27222 (.44)	-1.74713 (1.95)
a_1	.02270 (.13)	.20570 (1.51)	-.51723 (1.82)	.22225 (.59)	1.23084 (2.39)
a_2	-.00636 (.31)	-.02130 (1.38)	.06322 (1.93)	-.03061 (.70)	-.13826 (2.34)
$LEPROW_{i,future}$					
a_0	.59189 (1.69)	.02689 (.06)	-.22295 (.27)	-1.78692 (1.47)	-.18273 (.08)
a_1	-1.05448 (1.20)	-.19518 (.17)	.46889 (.26)	-.28900 (.10)	3.17049 (.65)
a_2	.32727 (1.09)	.02463 (.06)	-.18259 (.31)	.59436 (.60)	-1.42446 (.86)
$LEPROW_{i,past}$					
a_0	-.18811 (.69)	.51740 (1.48)	.34201 (.50)	-.55935 (.61)	1.68519 (1.03)
a_1	.30444 (1.93)	-.28480 (1.38)	-.13454 (.33)	.31225 (.58)	-.40620 (.39)
a_2	-.04044 (2.26)	.03337 (1.41)	.01730 (.37)	-.03135 (.52)	.01144 (.09)

Table A.5 : Estimated coefficients for polynomial approximations
using quarterly data.

The estimated equations have the form

$$\text{LMSD}_{-1} = \sum_n \sum_t a_n t^n \text{LEPD}_t + \sum_n \sum_t a_n' t^n \text{LEPROW}_{D,t} \quad \text{where } t = 0, \dots, 7$$

indicates the number of lags of the price variables. Thus $t' = t + 1$ indicates the number of leads or lags with respect to the dependent importshare variable. The data ($t = 0$) cover the period 1970.III through 1975.IV, that is 22 quarterly observations. All equations include a constant; the equations concerning imports from Italy, the U.K., and the U.S. contain also seasonal dummies.

The following table contains the estimated coefficients for a second degree polynomial approximation allowing for one future, the present, and six past observations of the price variables.

	Germany	France	Italy	U.K.	U.S.
Own price					
a_0	.74836 (2.27)	.56469 (2.49)	.13992 (.26)	.16692 (.24)	.21425 (.24)
a_1	-.52814 (1.62)	-.57843 (3.04)	-.26822 (.84)	-.35801 (.45)	.44502 (.46)
a_2	.05901 (1.04)	.07882 (2.97)	.03615 (.86)	.04707 (.39)	-.12986 (.98)
Rest-of-the-world price					
a_0	-.02830 (.06)	-.29439 (1.01)	-.82264 (1.06)	-1.38038 (.89)	1.23751 (.45)
a_1	.36289 (1.61)	.51020 (2.25)	.46218 (.77)	.86113 (.74)	-2.13312 (1.21)
a_2	-.05992 (2.61)	-.07488 (2.39)	-.03991 (.42)	-.09996 (.67)	.33964 (1.41)
R^2 (corr.)	.4617	.6012	.6399	.4586	.4390
D.W.	2.4804	2.2982	2.9830	2.6365	2.2112
F (dummies)			9.876	5.992	6.608

The following table contains the estimated coefficients for a second degree polynomial approximation allowing for one future, the present, and nine past observations of the price variables.

	Germany	France	Italy	U.K.	U.S.
Own price					
a_0	.77828 (1.27)	-.47023 (1.80)	-.26943 (.61)	.36623 (.72)	-.72625 (.71)
a_1	-.31479 (1.06)	.14569 (1.13)	.11256 (.35)	-.48154 (1.13)	.22402 (.29)
a_2	.02169 (.91)	-.01139 (.91)	-.01010 (.35)	.05499 (1.19)	-.02737 (.35)
Rest-of-the-world price					
a_0	-.09244 (.33)	.68289 (2.26)	-.18562 (.20)	-1.86092 (1.34)	.56939 (.24)
a_1	.18525 (.79)	-.28490 (1.80)	.04409 (.08)	.90424 (1.67)	-.18546 (.17)
a_2	-.01769 (.97)	.02717 (1.72)	.00033 (.01)	-.08105 (1.87)	.00423 (.05)
R^2 (corr.)	.3862	.5138	.6118	.4899	.5228
D.W.	2.3525	2.2621	2.7862	2.7925	2.6746
F (dummies)			11.684	5.582	7.778

The following table contains the estimated coefficients for a third degree polynomial approximation allowing for one future, the present, and nine past observations of the price variables.

	Germany	France	Italy	U.K.	U.S.
Own price					
a_0	1.54945 (2.18)	.32852 (.81)	.64550 (.95)	1.00579 (.81)	-3.44404 (1.50)
a_1	-.55850 (.79)	-.65977 (1.93)	-1.55171 (1.70)	-1.47542 (.90)	2.45674 (1.18)
a_2	-.00332 (.02)	.16827 (2.36)	.32858 (1.73)	.31170 (.81)	-.27010 (.67)
a_3	.00454 (.43)	-.01109 (2.57)	-.01898 (1.63)	-.01699 (.70)	.00119 (.04)

	Germany	France	Italy	U.K.	U.S.
Rest-of-the-world price					
a_0	-.78599 (1.71)	-.15708 (.38)	-2.75787 (1.74)	-3.25566 (1.19)	4.58937 (1.10)
a_1	.96228 (2.48)	.64625 (1.73)	2.67310 (1.65)	2.33864 (1.13)	-.17534 (.06)
a_2	-.14783 (1.87)	-.17210 (2.26)	-.46697 (1.38)	-.40562 (.94)	-.48648 (.60)
a_3	.00665 (1.21)	.01140 (2.59)	.02265 (1.09)	.02027 (.77)	.04954 (.84)
R^2 (corr.)	.5289	.6391	.6617	.4220	.5141
D.W.	2.7308	2.7154	2.9807	2.8878	3.0186
F (dummies)			11.550	4.816	6.522

Table A.6 : An alternative test for the significance of future prices as explanatory variables.

To obtain an alternative measure for the significance of the coefficients for future prices, reflecting expectations, we reestimated the relationships using the coefficient patterns obtained in the last iteration series as constraints to eliminate the problem posed by serially correlated error terms (i.e. low D.W. statistic indicating that F and t-test are inoperable; cf. the above discussion of the Sims-test pp. 65 - 68).

The equations estimated thus have the form

$$LMS_i = a_1(b_{+1}LEP_{i,+1}) + a_2(b_{-t}LEP_{i,-t}) + a_3(c_{+1}LEPROW_{i,+1}) + a_4(c_{-t}LEPROW_{i,-t}) + \text{dummies} + \text{constant}.$$

The following table contains these a-coefficients, the respective t-values (in brackets) as well as the F-values corresponding to the hypothesis that $a_1 = a_2 = 0$. The equations concerning imports from Germany and from France contain no dummies. The data are the same as in table A.5.

	Germany	France	Italy	U.K.	U.S.
a_1	1.149 (3.78)	1.063 (3.31)	.686 (.28)	1.635 (.67)	1.556 (.85)
a_2	1.043 (5.89)	.997 (6.83)	.988 (2.90)	.873 (3.35)	.115 (.05)
a_3	1.638 (1.30)	1.636 (.94)	.916 (1.48)	.776 (2.77)	-7.236 (.26)
a_4	1.036 (5.04)	1.018 (6.83)	.985 (3.50)	1.037 (2.21)	-1.342 (.13)
F_{Add}	9.155	10.412	4.803	4.359	1.132
d.f.	(2;17)	(2;17)	(2;14)	(2;14)	(2;14)
R^{2*}	.6991	.7742	.8174	.6984	.5132
D.W.	2.595	2.285	2.991	2.679	1.453

These results are virtually identical with the ones presented on pp. 96 - 98. The relaxation of the constraints concerning the possible coefficient configurations has produced little or no improvement in goodness of fit (R^{2*}). With the exception of the U.S. case, we have now a confirmation that the inclusion of the future

price values as explanatory variables is meaningful. The above F-values (as well as the t-values) confirm that their coefficients are significantly different from zero.

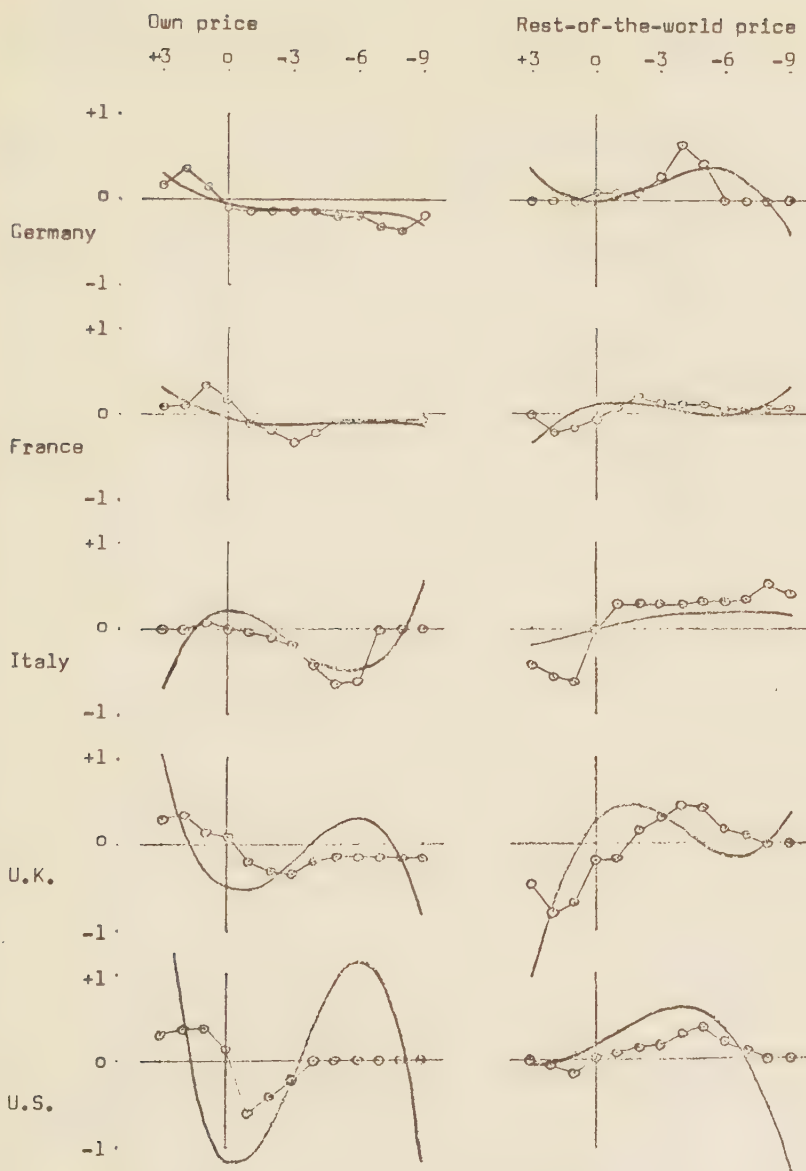


Fig.13 Graphical Comparison of Polynomial (—) and Iteration (—○—) Approximations. Monthly date 1969.1 - 1975.12 ($n = 84$).
(cf. pp. 86 - 89)

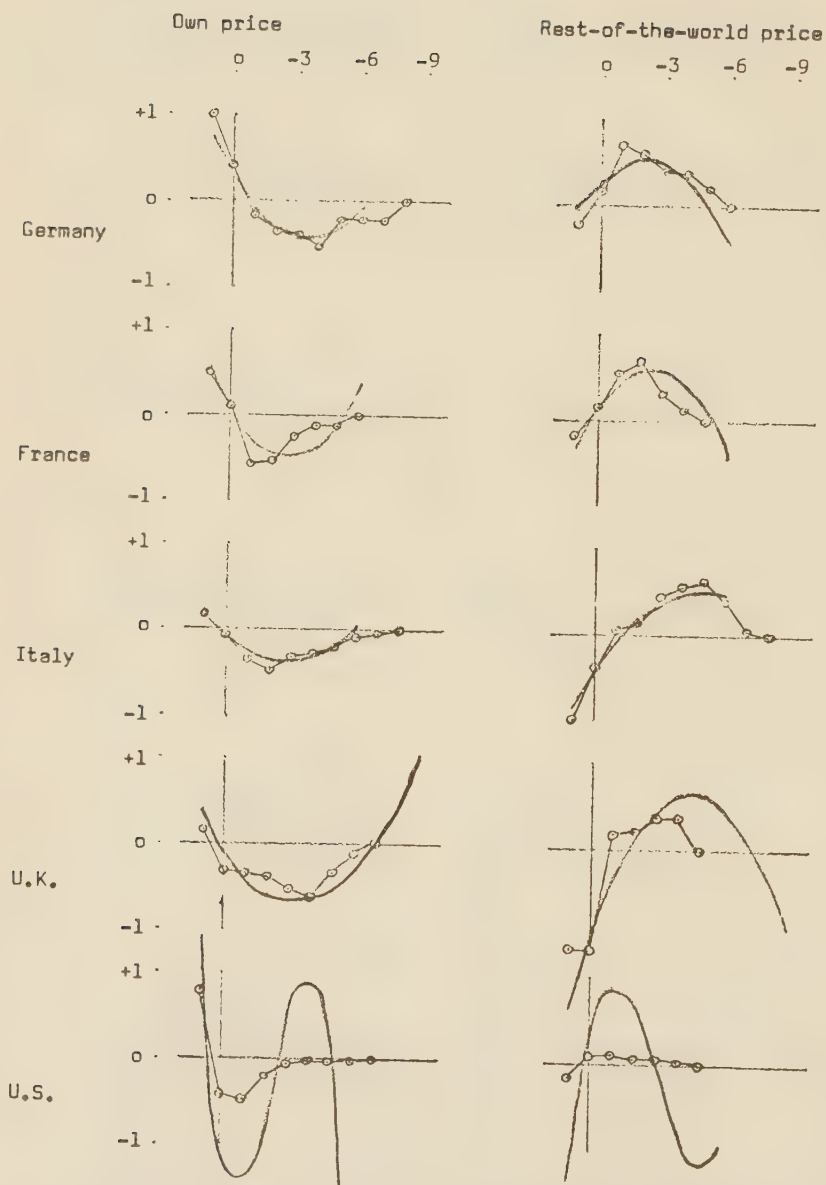


Fig.14 Graphical Comparison of Polynomial (—) and Iteration (—○—) Approximations. Quarterly data 1970.III - 1975.IV (n = 22). (cf. pp. 96 - 98)

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